

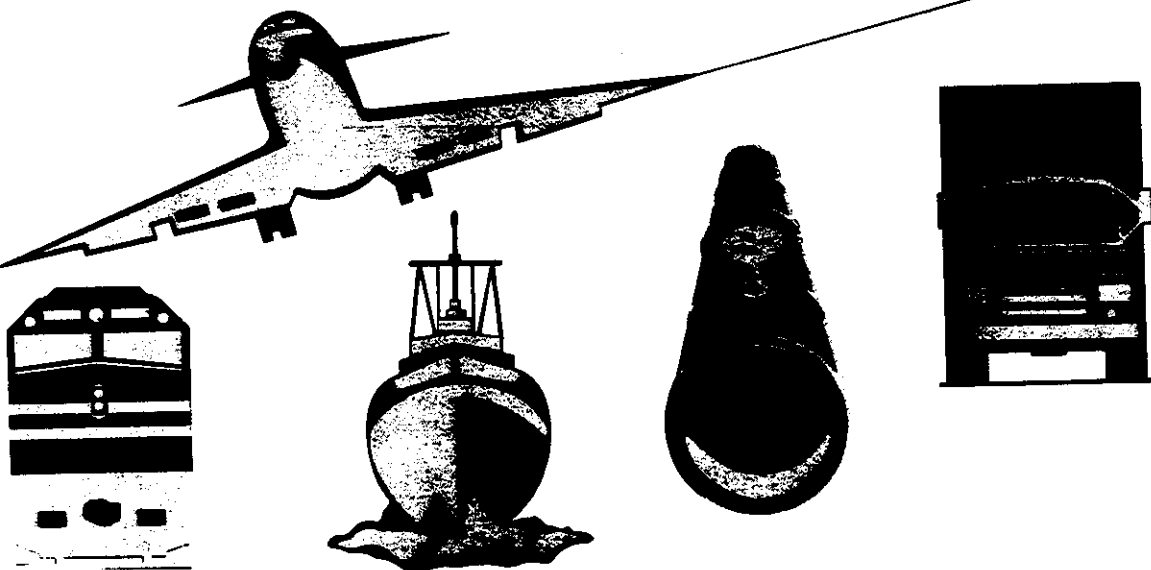
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NATIONAL TRANSPORTATION SAFETY BOARD

TRANSPORTATION SAFETY RECOMMENDATIONS

**ADOPTED DURING THE MONTH
OF JUNE, 1998**



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16. Abstract <p>This publication contains safety recommendations in aviation, marine and railroad modes of transportation adopted by the National Transportation Safety Board during the month of June, 1998.</p> <table border="0"> <tr> <td><u>AVIATION</u></td> <td><u>RAILROAD</u></td> </tr> <tr> <td>A-98-41 and 42</td> <td>R-98-17</td> </tr> <tr> <td>A-98-43</td> <td>R-98-18 through 25</td> </tr> <tr> <td><u>MARINE</u></td> <td>R-98-26 through 30</td> </tr> <tr> <td>M-98-85 and 86</td> <td>R-98-31</td> </tr> <tr> <td>M-98-87 through 91</td> <td></td> </tr> <tr> <td>M-98-92</td> <td></td> </tr> <tr> <td>M-98-93</td> <td></td> </tr> <tr> <td>M-98-94</td> <td></td> </tr> <tr> <td>M-98-95 through 97</td> <td></td> </tr> <tr> <td>M-98-98 and 99</td> <td></td> </tr> <tr> <td>M-98-100 and 101 and M-98-102 and M-93-1</td> <td></td> </tr> </table>						<u>AVIATION</u>	<u>RAILROAD</u>	A-98-41 and 42	R-98-17	A-98-43	R-98-18 through 25	<u>MARINE</u>	R-98-26 through 30	M-98-85 and 86	R-98-31	M-98-87 through 91		M-98-92		M-98-93		M-98-94		M-98-95 through 97		M-98-98 and 99		M-98-100 and 101 and M-98-102 and M-93-1	
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National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: June 25, 1998

In reply refer to: A-98-41 through -42

Honorable Jane F. Garvey
Administrator
Federal Aviation Administration
Washington, D.C. 20591

On April 28, 1997, at 1222 mountain standard time, American Airlines flight 230, a McDonnell Douglas MD-82, sustained a left engine turbine section fire and tailpipe fire shortly after takeoff from the Tucson International Airport, Tucson, Arizona. The flight was operating in visual flight rules conditions under Title 14 Code of Federal Regulations (CFR) Part 121 as a scheduled domestic passenger flight from Tucson to Dallas-Fort Worth, Texas. The 5 crewmembers and 118 passengers sustained no injuries.

The captain stated that he heard a loud bang as the aircraft was climbing through 1,800 feet, and the left engine "spooled down." A left engine fire extinguisher bottle was activated to control the fire, and the engine was secured. The flight returned and landed on runway 29R. As airport rescue and firefighting (ARFF) personnel extinguished a fire in the left engine tailpipe, the flightcrew attempted to contact them on the ground control frequency. By the time radio contact was made, approximately 16 passengers had exited the aircraft via the forward left door slide, and several other passengers had climbed onto the right wing to evacuate. The flight attendant stated that she saw firetrucks and firemen outside the cabin door and one fireman "gave me the thumbs up, then I proceeded to open the door." The firefighter stated that he gave the "thumbs up" hand signal to stop the evacuation. The ARFF personnel stopped the passengers from evacuating the aircraft and directed them back inside the airplane. The remaining passengers eventually deplaned using portable stairs.

During a debriefing session of the incident, ARFF personnel determined that the evacuation of this aircraft was not necessary and that the aircraft could have been safely towed to a gate. The passengers could have safely deplaned at that point. During the discussions, ARFF personnel stated that if they had a direct means of communicating with the flightcrew, unnecessary evacuations such as this one could be avoided.

On July 8, 1996, about 0741 central daylight time, Southwest Airlines flight 436, a Boeing 737-200, N53SW, received minor damage during a rejected takeoff (RTO) from runway

20C at the Nashville Metropolitan Airport, Nashville, Tennessee. The airplane was operated as a regularly scheduled domestic passenger flight under the provisions of 14 CFR Part 121. The airplane stopped approximately 750 feet off the departure end of runway 20C, about 100 feet east of the extended centerline. The 5 crewmembers and 122 passengers evacuated using the emergency slides. One passenger received serious injuries, and four passengers received minor injuries during the emergency evacuation.

After completing the emergency checklist and announcing over the public address system that the passengers should remain seated, the captain saw that the fire department equipment had arrived. The captain and the ARFF on-scene supervisor established voice communications through the captain's open cockpit window. The ARFF supervisor reported to the captain that the tires were smoking and deflating. The right main landing gear ignited and was immediately extinguished with foam. After hearing a fire warning and without determining the location or severity of the fire, the flight attendants initiated an aircraft evacuation. During the evacuation, the left main landing gear ignited and was immediately extinguished. Although the flightcrew was able to communicate with the ARFF personnel through the open cockpit window, the Nashville Metropolitan Airport Authority determined that a designated radio frequency might have allowed the ARFF personnel to advise the flightcrew about the situation in a more timely manner. Therefore, the flightcrew might have been able to coordinate with the flight attendants and prevent an evacuation. As a result of this accident, a designated frequency was assigned for use during accidents and incidents at the Nashville airport.

Eight major airports in the United States have instituted a designated frequency for emergency use.¹ On June 19, 1996, Delta Air Lines flight 229, a Boeing 767-332, returned to the Salt Lake City Airport, Salt Lake City, Utah, after the flightcrew detected a fire in the right engine; although the fire was still burning, ARFF personnel and the flightcrew decided not to evacuate the airplane while ARFF members extinguished the fire. Although before this incident the Salt Lake City Airport did not have a designated frequency, the ground controller provided the flightcrew and ARFF personnel a discrete frequency on which to communicate that resulted in improved emergency response. The flightcrew was able to taxi the aircraft to a gate under the airplane's own power. The passengers and crew sustained no injuries.

The Tucson and Nashville incidents illustrate the need for flightcrews and ARFF personnel to have the ability to communicate with each other directly. A designated radio frequency allows ARFF personnel to issue critical information concerning the exact nature of, and hazards associated with, an emergency in progress. Consequently, the Safety Board believes that the FAA should establish a designated radio frequency at all airports certified under Title 14 CFR Part 139 that allows direct communication between ARFF personnel and flightcrew members in the event of an emergency and take appropriate measures to ensure that air traffic control personnel, ARFF personnel, and pilots are aware of its designation.

¹ The airports are located in Covington/Cincinnati, Ohio (CVG); Honolulu, Hawaii (HNL); Seattle, Washington (SEA); Nashville, Tennessee (BNA); Los Angeles, California (LAX); Fort Lauderdale, Florida (FLL); Philadelphia, Pennsylvania (PHL); and Boston, Massachusetts (BOS).

The Safety Board is also concerned that ARFF personnel may not be able to communicate with a flightcrew if power is lost or if the flightcrew must abandon the cockpit. Following RTOs and emergency landings, flightcrews may shutdown the airplane's electrical power, rendering two-way radio communications ineffective. Consequently, the Safety Board believes that the FAA should develop a universal set of hand signals for use between ARFF personnel and flightcrews and flight attendants for situations in which radio communication is lost.

Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Establish a designated radio frequency at all airports certified under Title 14 CFR Part 139 that allows direct communication between airport rescue and firefighting (ARFF) personnel and flightcrew members in the event of an emergency and take appropriate measures to ensure that air traffic control personnel, ARFF personnel, and pilots are aware of its designation. (A-98-41)

Develop a universal set of hand signals for use between airport rescue and firefighting personnel and flightcrews and flight attendants for situations in which radio communication is lost. (A-98-42)

Chairman HALL, Vice Chairman FRANCIS, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in these recommendations.

By:


Jim Hall
Chairman



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: June 25, 1998

In reply refer to: A-98-43

Honorable Jane F. Garvey
Administrator
Federal Aviation Administration
Washington, D.C. 20591

On December 26, 1995, a Piper PA-46-310P, N800SJ, lost engine power during cruise flight and crashed at Ocala, Florida, while attempting to perform an emergency landing.¹ The pilot and one of the passengers were seriously injured. The National Transportation Safety Board's examination of the engine disclosed detonation damage to the No. 6 cylinder piston and scoring of the piston sidewalls at five of the six cylinders. The engine turbocharger's turbine-inlet temperature (T.I.T.) gauge was tested and found to read low; at the 1,750°F test point (maximum continuous T.I.T.), the gauge indicated only about 1,640°F.

The Safety Board determined that the probable cause of the accident was "oil starvation resulting in connecting rod failure in three of the six cylinders due to lack of lubrication." At the request of the Safety Board, maintenance personnel checked the calibration of T.I.T. gauges in nine PA-46 series airplanes (seven PA-46-350P models and two PA-46-310P models). Three of the gauges indicated correctly at the 1,750°F test point; the other gauges indicated 60° to 110° low.

On April 26, 1996, Piper issued Service Bulletin (SB) No. 995A, "Turbine Inlet Temperature (T.I.T.) System Calibration and Probe Replacement." Under "PURPOSE" the bulletin states the following:

Field reports indicate that the accuracy of the existing [T.I.T.] probe may decrease over time in service. The corrosive and very hostile environment experienced in the exhaust system has dictated that Piper establish a 250 hour service life for the T.I.T. probe. In addition, a new calibration procedure has been established to check the accuracy of the indicator and wiring. Failure to calibrate the T.I.T. system or to replace the T.I.T. probe as prescribed, may lead to inaccurate or erroneous T.I.T. indications, and possible engine damage.

¹ For more detailed information, read Brief of Accident MIA96FA049 (enclosed).

This Service Bulletin consists of two (2) PARTS which address the T.I.T. system:

PART I provides for the application of a new calibration procedure for the T.I.T. system (one time).

PART II requires an initial replacement of the T.I.T. probe at the compliance time listed above and requires repetitive replacement by establishing a normal service life. (On PA-46-350P aircraft only.)

Failure to comply with this Service Bulletin may result in damage to or shorten the life of the powerplant. Compliance must occur at or within the compliance times indicated.

The calibration procedure is applicable to Lewis T.I.T. gauges, Piper Part Number 471-008 or 548-011 and is required each time a T.I.T. gauge is replaced or if a system error is suspected. SB 995A indicates that T.I.T. probe replacement must occur at cylinder changes, at engine overhauls, or if other T.I.T. system maladies become apparent.

The PA-46-310P Pilot's Operating Handbook (POH) indicates that the airplane's cruise fuel mixture setting should be established at 50° lean of peak T.I.T. The POH outlines a procedure for doing so and indicates that although the procedure differs from conventional leaning procedures, the airplane should never be operated in cruise with a fuel mixture setting other than 50° lean of peak T.I.T. The POH contains the following precautionary note in connection with establishing the peak T.I.T.:

Maximum continuous T.I.T. is 1750°F. Temporary operation up to 1800°F is permitted in order to define peak T.I.T. In no case should the aircraft be operated more than 30 seconds with a T.I.T. in excess of 1750°F.

The Safety Board agrees with the importance of adhering to Piper's cruise fuel mixture setting procedure. However, in view of the accident involving N800SJ and the critical importance of adhering to the engine turbocharger's T.I.T. limitation, the Safety Board is concerned that use of inaccurate T.I.T. gauges to define the peak T.I.T. may result in or contribute to inadvertent engine damage and an in-flight loss of power. Therefore, the Safety Board believes that the FAA should issue an airworthiness directive, applicable to both Piper PA-46-310P and PA-46-350P model airplanes, requiring compliance with Piper SB 995A, "Turbine Inlet Temperature (T.I.T.) System Calibration and Probe Replacement."

Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Issue an airworthiness directive, applicable to both Piper PA-46-310P and PA-46-350P model airplanes, requiring compliance with Piper Service Bulletin No. 995A, "Turbine Inlet Temperature (T.I.T.) System Calibration and Probe Replacement." (A-98-43)

Chairman HALL, Vice Chairman FRANCIS, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in this recommendation.

By:

A handwritten signature in black ink, appearing to read "Jim Hall". The signature is written over a circular stamp that contains the text "Jim Hall".

Chairman

Enclosure

National Transportation Safety Board
Washington, D.C. 20594

Brief of Accident

Adopted 04/15/98

MIA96FA049
FILE NO. 1991 12/26/95 Ocala, FL AIRCRAFT REG NO. N800SJ TIME (LOCAL) - 22:45 EST

MAKE/MODEL - Piper-PA-46-310P
ENGINE MAKE/MODEL - Continental TSIO-520-BE
AIRCRAFT DAMAGE - Substantial
NUMBER OF ENGINES - 1
OPERATING CERTIFICATES - NONE
TYPE OF FLIGHT OPERATION - Personal
REGULATION FLIGHT CONDUCTED UNDER - 14 CFR 91

FATAL CREW 0
PASS 0
SERIOUS 1
MINOR/NONE 0
5

LAST DEPARTURE POINT DESTINATION - KISSIMMEE, FL
- BIRMINGHAM, AL

AIRPORT PROXIMITY - Off airport/airstrip
AIRPORT NAME - Ocala Regional/Jim Taylor
RUNWAY IDENTIFICATION - Unk/Nr
RUNWAY LENGTH/WIDTH (Feet) - Unk/Nr
RUNWAY SURFACE - Unk/Nr
RUNWAY SURFACE CONDITION - Unk/Nr

CONDITION OF LIGHT - Night (dark)

WEATHER INFO SOURCE - Weather observation facility

BASIC WEATHER - Visual (VMC)
LOWEST CEILING - None
VISIBILITY - 10.000 SM
WIND DIR/SPEED - 350 /003 KTS
TEMPERATURE (F) - 33
OBSTR TO VISION - None
PRECIPITATION - None

PILOT-IN-COMMAND AGE - 44

CERTIFICATES/RATINGS
Private
Single-engine land, Multiengine land
INSTRUMENT RATINGS
Airplane

FLIGHT TIME (Hours)

TOTAL ALL AIRCRAFT - 1500
LAST 90 DAYS - 2
TOTAL MAKE/MODEL - 500
TOTAL INSTRUMENT TIME - Unk/Nr

During cruise flight at 14,000 feet mean sea level, the engine failed. The flight was vectored to a nearby airport but the pilot flew toward another airport and crashed in a residential area. Examination of the engine revealed 1.8 quarts of oil were drained and 3 of the 6 connecting rods were failed due to lack of lubrication. Also, detonation damage to the No. 6 cylinder piston was noted and scoring of piston sidewalls was noted at 5 of the 6 cylinders. Evidence of heat discoloration was noted to the connecting rod journals for 3 of the 6 cylinders. The aircraft TIT gauge, which had been miscalibrated by 30 to 40 degrees when the airplane was manufactured, was found to indicate 110 degrees Fahrenheit low near the maximum continuous point of 1,750 degrees. The air/oil separator hose to the scavenge pump was plugged about 10 inches along its length with a substance with a high lead content resulting in the recurring pilot report of excessive oil consumption. Due to the pilot complaint of excessive oil consumption 4 of the 6 cylinders were removed and replaced within the previous 6 months. About 1 month before the accident one of the cylinder pistons was removed and replaced after examination revealed piston sidewall damage consistent with detonation.

Brief of Accident (Continued)

MIA96FA049

FILE NO.1991

12/26/95

OCALA, FL

AIRCRAFT REG NO. N800SJ

TIME (LOCAL) - 22:45 EST

Occurrence# 1

Phase of operation LOSS OF ENGINE POWER (TOTAL) - MECH FAILURE/MALF
CRUISE - NORMAL

Findings

1. ENGINE INSTRUMENTS, TIT GAGE - FALSE INDICATION
2. MAINTENANCE, CALIBRATION - IMPROPER - MANUFACTURER
3. MAINTENANCE, CALIBRATION - NOT PERFORMED - OTHER MAINTENANCE PERSONNEL
4. ENGINE ASSEMBLY, PISTON - SCORED
5. FLUID, OIL - STARVATION
6. ENGINE ASSEMBLY, CONNECTING ROD - FAILURE, TOTAL

Occurrence# 2

Phase of operation IN FLIGHT COLLISION WITH OBJECT
EMERGENCY DESCENT/LANDING

Findings

7. OBJECT - TREE(S)
8. ATC CLEARANCE - DISREGARDED - PILOT IN COMMAND

The National Transportation Safety Board determines the probable cause(s) of this accident was:
oil starvation resulting in connecting rod failure in three of the six cylinders due to lack of lubrication.
Contributing to the accident was the failure of the pilot to adhere to a ATC vector toward the nearest airport
following engine failure which resulted in the airplane flying past the vectored airport and subsequent collision with
trees.



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: June 25, 1998

In reply refer to: M-98-85 and M-98-86

To the Manufacturers
of Personal Watercraft
(see attached mailing list)

Personal watercraft (PWC) are a type of recreational boat that has become increasingly popular in recent years. Manufacturers estimate that about 200,000 PWC are sold each year, and more than 1 million are in current operation. PWC now account for more than one-third of the new recreational boat sales in the United States.

Although the overall number of recreational boating fatalities has been declining in recent years, the number of personal watercraft-related fatalities has been increasing. At the time of the National Transportation Safety Board's 1993 recreational boating safety study, there were only 26 personal watercraft fatalities a year, and the Safety Board did not believe that separate consideration of PWC was warranted. However, in 1994, the number of PWC fatalities began to increase noticeably because the number of PWC in operation increased. Preliminary numbers for 1997 indicate 83 PWC fatalities. PWC are the only type of recreational vessel for which the leading cause of fatalities is not drowning; in PWC fatalities, more persons die from blunt force trauma than from drowning. The increase in fatalities and the distinctive way in which fatalities occur prompted the Safety Board to examine the nature of PWC accidents.

The Safety Board initiated a study to more closely examine fatalities and injury in addition to accident characteristics associated with PWC accidents.¹ The study was not designed to estimate how often PWC accidents occur. The Safety Board examined 1,739 PWC accident reports for accidents that occurred during an 18-month period, January 1996 through June 1997. For PWC accidents that occurred between January and June 1997, the Safety Board requested that State marine accident investigators provide the Safety Board with copies of their accident reports and complete a supplemental questionnaire prepared by the Safety Board specifically for this study. The goal of the supplemental questionnaire was to obtain additional information concerning the accident characteristics and details concerning personal injury that have not

¹ National Transportation Safety Board. 1998. Personal Watercraft Safety. Safety Study NTSB/SS-98/01. Washington, DC.

previously been available from State boating accident reports. State accident reports and supplemental information were the sources of the Safety Board's accident information.

For the January-June 1997 period, the Safety Board received boating accident reports and questionnaire responses from 37 participating States and Territories. Boating accident reports were not always accompanied by supplemental questionnaires. Also, because of concerns over personal privacy issues, five States² did not provide the Safety Board with copies of their boating accident reports but did provide supplemental questionnaires. Consequently, the boating accident reports and the supplemental questionnaires represent two different but substantially overlapping sets of data, which contain information on a total of 814 PWC accidents involving 1,218 operators.

The Safety Board also reviewed State reports of PWC accidents that occurred in 1996. A total of 49 States and Territories provided either copies of their boating accident report forms, automated boating accident report database files, or summary information for 1996 and/or 1997.

Because the States voluntarily provided the Safety Board with accident reports and supplemental questionnaire information, and because of the incomplete nature of much of the information, the Safety Board does not claim that the results of the study are representative of all PWC accidents. The Safety Board analyzed 814 (one-third) of the 1997 reported accidents and examined all of the data for the 1996 reported accidents. Consequently, the Board believes that a substantial number of accidents was available to identify the most important safety issues associated with PWC accidents. Further, the Safety Board's analysis did not show any biases in the types of accidents in the half-year of 1997 accidents compared to the full year of 1996 accidents. The Safety Board's interest in truncating the data collection period to 6 months was based on a goal of providing the results of this study prior to the 1998 summer boating season.

Based on the analysis of the data reviewed, the safety issues discussed in the Safety Board's report include the following: protecting personal watercraft riders from injury, operator experience and training, and boating safety standards. The study also addresses the need for recreational boating exposure data. The discussion in this letter is limited to the issues of protecting personal watercraft riders from injury and boating safety standards.

The Safety Board's study of PWC accidents specifically examined injury type and severity. According to Coast Guard data for 1996, drowning is the leading cause of death for all recreational boating accidents (500 of 709); however, injuries of blunt force trauma are more common to the operators and passengers of PWC. Of the 57 deaths attributed to PWC accidents in the Coast Guard 1996 data, 42 PWC operators or other boaters (74 percent) died from causes other than drowning. This distinction led the Safety Board to examine the injury characteristics of PWC accidents to see if there were special considerations for the safe use of these vessels.

² California, Delaware, Nevada, Washington, and the Territory of Puerto Rico.

Injury Coding

For the 1997 PWC accidents resulting in injury, marine investigators indicated injury location on body diagrams on the Safety Board's supplemental questionnaire and, in many cases, the investigator also provided text descriptions of the injuries. To provide some level of assessment of injury severity, Safety Board staff used this information to code each injury according to the Abbreviated Injury Scale, 1990 Revision (AIS 90).³ The AIS, developed by the Association for the Advancement of Automotive Medicine, offers a standardized system for categorizing injury type and severity.⁴ Each injury description was assigned a 6-digit numerical code in addition to an AIS severity score. A composite Injury Severity Score, ISS, was calculated for each victim based on the sum of the squares of the highest AIS severity score in each of the three most severe injuries from a defined set of six body regions.⁵

AIS was originally developed in the early 1970s for impact injury assessment, but subsequent revisions (1976, 1980, 1985, and 1990) have incorporated coding for brain injuries, penetrating trauma, vascular injuries, and burns. AIS 90 includes specific coding rules, which the Safety Board followed to code the injuries in the study cases, and a dictionary of over 2,000 injury descriptions. Because AIS was initially developed to assess injury to victims that were involved in emergency care (that is, its function was to project survivability), it has some limitations for postmortem assessment of injury. For the purposes of this study, fatalities were coded with a maximum severity code, ISS = 75, regardless of the AIS injuries associated with that victim. Drowning was coded as severe inhalation.

Injured Persons

Injuries were recorded for anyone involved in a PWC accident: operators of vessels (whether they were at fault or not), passengers, boaters, swimmers, skiers, and in one case, a nonwater victim. Injury of some level was sustained in 61 percent of the study accidents (500 of 814); there were 563 injured persons in these 500 accidents. The 563 injured persons sustained a total of 835 separate injuries; some persons sustained more than one injury; and multiple injuries were coded separately (this accounts for the larger number of injuries compared to the number of injured persons). Two percent of the reported injuries (15 of 835 injuries) did not contain sufficient information to enable AIS coding.

Although PWC operators were the most likely persons to be killed or injured in the PWC accidents examined for the study, 37 of the persons injured or killed (7 percent) can be considered bystanders; that is, they were not operating a PWC nor were they a PWC passenger. Consumer

³ The Safety Board staff member who coded the injury data had a nursing background, and an NTSB staff physician was available to answer questions.

⁴ AIS 90, which was released in 1990, is the most recent coding revision. A new version, AIS 98, is expected to be released in 1998.

⁵ Baker, S.P.; O'Neill, B.; Haddon, W.; Long, W.B. 1974. The injury severity score: a method for describing patients with multiple injuries and evaluating emergency care. *Journal of Trauma*. 14: 187-196.

Product Safety Commission accident reports for 1997 contain similar reports of injury and death to persons who were not the PWC operators or passengers, but were swimmers, scuba divers, and persons tubing and skiing.⁶

Fatalities

Of the 563 injured persons, 27 were fatally injured. Fatalities included 24 PWC operators, one passenger, one boater, and one swimmer. The characteristics of fatal accidents differed little from those of all PWC accidents. Vessel collisions were the leading type of fatal accidents (40 percent), and when combined with collisions with objects (16 percent), collisions accounted for more than half of all fatal accidents. Overboard was indicated as the type of accident for 30 percent of the fatalities. Each fatality occurred in a separate accident.

Operator inexperience and inappropriate speed were the leading reported causes of the fatal PWC accidents, and they were two of the three leading causes of all PWC accidents. Fewer rented PWC in the Safety Board's sample were involved in fatal accidents; rented PWC accounted for 36 percent of all accident vessels but were only 11 percent of fatal accident vessels.

Types of Injuries

Minor injuries accounted for the majority of the injuries reported (61 percent, or 513 of the 835 separate injuries); moderate injuries accounted for 25 percent (210 of 835). For the purpose of discussion, injuries coded "moderate" under AIS could include fracture of the pelvis, dislocated knee, major skin laceration, two to three broken ribs, or retinal detachment in the eye. There were 68 serious injuries (8 percent); injuries coded severe, critical, and maximum accounted for 3.5 percent.

Lower Extremity Injuries. Collision between two PWC was the most frequent type of accident. When two PWC collide, the likely impact area is slightly above the waterline, where feet and legs straddle the vessel. A high proportion (one-third) of injuries in the Safety Board's 1997 sample occurred in the lower extremities. Skeletal fractures and breaks occurred more frequently than all other types of injuries to the lower extremities; for the 286 injuries to the lower extremities, more than half (165, or 58 percent) were skeletal fractures or breaks. Combined injuries for upper and lower extremities accounted for nearly half (47.5 percent) of all injuries. However, injury to an extremity is rarely life threatening (all but one type of lower extremity injury is defined as AIS-3 or less).

For the PWC accidents involving a single vessel, there were 110 reported injuries to lower extremities. Nearly half (52) involved broken bones (the remaining were contusions, abrasions, and bleeding). This high percentage of broken legs and ankles in accidents that did not involve

⁶ In two cases, PWC struck and killed a swimmer; in two cases, PWC struck and killed a scuba diver; and in three cases, a PWC struck and killed persons who were tubing or skiing.

collision indicates that operators are being injured by their own vessel. The following case examples illustrate the events:

- In the description of one accident, the investigator stated, "Two people on board; made a right turn and flipped to the left catching the operator's leg and breaking it." The resulting break was to the operator's left leg about halfway between the ankle and knee.
- The witness of another accident provided the investigator with the following statement: "[the individual] was just playing around doing figure 8 circles and was going to turn around to stay out of the no-wake zone and a wave hit the side of the Waverunner catching her off guard and threw her off the side. Her ankle got caught between the side and the seat."
- Another accident report included the following statement: "While turning to the right to cross the wake of another vessel, at an excessive speed, the operator was thrown to the left. His foot became stuck in the foot well causing his leg to be broken."

The Safety Board's study did not address the mechanisms of injury; it would be difficult for any large-scale study to do that because of the isolated nature of PWC accidents. However, based on the anecdotal evidence of how injury occurred, it is suspected that some proportion of injury to lower extremities is associated with entrapment of the operator's feet as the person is ejected from the PWC.

Head Injuries. Of greater concern than leg injuries are injuries to the head, neck, and face because these injuries are generally more life threatening than are injuries to the extremities. Head, neck, and facial injuries accounted for one of every four injuries reported in the PWC accidents examined for this safety study. Injuries to the head contain many examples of more severe injuries (severe = AIS 4, critical = AIS 5, maximum = AIS 6). These type of injuries would include most penetration injuries to the head, open lacerations to intracranial vessels, or skull fractures. Because of the AIS coding definitions, it would be expected that head injuries for a large number of accidents would, on average, be more severe than leg injuries.⁷ The Safety Board's 1997 accident sample included 12 head injuries that were categorized as severe or higher (AIS = 4, 5, or 6), 9 of which were fatal (maximum AIS = 6).

A classic response to protect against head injuries would be the use of helmets. This has been true for motorcycling, bicycling, snowboarding, skateboarding, and an array of speed-related sports. The International Jet Sport Boating Association requires PWC riders in competitive races to wear helmets.⁸ However, there are many design questions that must be considered for PWC

⁷ The magnitude of AIS severity coding should not be compared for different body regions because injuries to some areas of the body are not as life threatening as to other areas; for example, injuries to the upper extremities are not as severe as injuries to the head. The AIS coding for upper extremities does not include any situation that can be coded beyond a severity level equal to 3 (minor = 1, moderate = 2, and serious = 3), whereas many head injuries are categorized higher than 3. Consequently, a comparison of average severity by body region is not valid.

⁸ 1998 Official Competition Rule Book of the International Jet Sport Boating Association.

helmet use; for example, should the helmet be a full-face or cutaway design, what is the best material for composition, should it have a face guard, and if so, how would water spray distort vision. Research on helmet load analysis for personal watercraft⁹ has concluded that "the likelihood of neck injury from impact with the water is significantly increased for riders with helmets even at normal riding speeds. Unless the potential for head injury due to collision is significant (like in racing), wearing a helmet is not recommended."¹⁰ Further research is warranted before appropriate head gear protection can be recommended. One PWC manufacturer summarizes the helmet issue as follows:

A helmet is designed to provide some head protection. Although helmets cannot protect against all foreseeable impacts, a helmet might reduce your injuries in a collision with a boat or other obstacle. A helmet may have potential safety hazards, as well. A helmet could catch the water during a fall into the water. This is commonly called "bucketing." The resulting strain on your neck could cause choking, severe and permanent neck injuries, or death. A helmet could also increase your risk of an accident if it reduces your vision or hearing, or if it distracts you or increases your fatigue.¹¹

A closer review of head injuries to separate injuries to the face and neck revealed that 113 injuries (49 percent of 232 head injuries) were facial injuries. Many accident reports contained descriptions of single-vessel accidents in which the operators hit their face on the vessel while jumping waves. Descriptive information included in the investigative reports cannot be assumed to be comprehensive (in many cases there was no indication of the mechanism of injury); consequently, the Safety Board's analyses cannot attribute cause to the facial injuries. However, descriptions such as those that follow provide examples that could be beneficial to future PWC design changes:

- A Missouri investigator stated that the "operator jumped the wake of a passing cruiser. When the PWC came down, the nose of the PWC went straight down into the water. Operator hit her head on the start/stop switch mounting, cutting her forehead. She was treated for lacerations and bruises at the local hospital."
- A Virginia operator stated that "when jumping wakes, you have no control when PWC is out of water." The operator received a laceration to the left eyebrow that required four stitches.

⁹ Robbins, Ron; Taylor, Robert K.; Fuller, Peter M. 1997. Neck loading due to head immersion in water at high speeds. In: Proceedings, 1997 International IRCOBi conference on the biomechanics of impact; 1997 September 24-26; Hanover, Germany. [Publisher's location unknown]: International Research Council on Biokinetics of Impacts: 455-456.

¹⁰ Taylor, Robert K. 1997. Presentation at the 1997 International IRCOBi conference on the biomechanics of impact; 1997 September 24-26; Hanover, Germany.

¹¹ Yamaha Motor Corporation, U.S.A. [n.d.] Yamaha Marine Water Vehicles, WaveRunner GP Owner's/Operator's Manual. Cypress, CA: p. 1-8.

- An Ohio operator stated that “while wake jumping, I came down and hit my handle bars.” The operator’s front tooth punctured his lower lip.

Safety Board staff visited a PWC dealer in metropolitan Washington, D.C., to examine handlebars of current models manufactured by Bombardier, Yamaha, and Kawasaki. The designs, for the most part, were composed of molded surfaces without edges; however, padding was minimal.

Spinal Injuries. The Safety Board’s study of the 1997 PWC accidents included 19 spinal injuries that were associated with single-vessel accidents. Seven of the injuries were reported by investigators¹² to have involved spinal breaks. A report from the University of Florida’s University Medical Center¹³ looked at serious spinal injuries. Over a 3-year period, that medical facility treated four patients who suffered fractured vertebrae associated with wave-jumping maneuvers. Similar injuries were found in the cases analyzed by the Safety Board. For example, an Ohio accident involved an experienced PWC operator¹⁴ crossing a large wake of a barge. The operator was thrown into the air and “came down on tail bone hard!” There was no property damage but the operator incurred a compression fracture to the spine.

Protecting PWC Riders From Injury

A study by the Centers for Disease Control (CDC) used 6 years (1990 through 1995) of hospital emergency room data (collected through the National Electronic Injury Survey System) to examine PWC-related injuries.¹⁵ A stratified sample of 624 injuries was used to estimate that 32,954 persons with PWC-related injuries were treated in U.S. hospitals nationwide. The distribution of injuries in the CDC study were as follows: head and neck (29.1 percent); arm (11.2 percent); upper trunk (11.7 percent); lower trunk (12.5 percent); and leg (34.4 percent). The proportions of head and leg injuries found in that study closely match those from the Safety Board’s sample. The CDC study specifically identified a case of facial injury resulting from impact with the PWC handlebars.

The CDC, in its report on PWC-related injuries, offered several suggestions that might help prevent injuries to PWC users, including specific training for PWC operators and

¹² For cases of serious injury, investigator reports often, but may not always, include information obtained from hospital visits.

¹³ Solis and others. 1998. Presentation at the 1998 annual conference of the American Academy of Orthopedic Surgeons, New Orleans, LA.

¹⁴ The accident description indicated that the operator had 12 years’ experience on boats and PWC, with over 500 hours on the type of PWC involved in the accident.

¹⁵ Branche, Christine M.; Conn, Judith M.; Annett, Joseph L. 1997. Personal watercraft-related injuries: a growing public health concern. *Journal of the American Medical Association*. 278(8): 663–665. August 27.

enforcement.¹⁶ The Safety Board agrees with the CDC that PWC operators should receive education and training specific to PWC and is recommending that the States, the National Association of State Boating Law Administrators (NASBLA), the U.S. Power Squadrons, BOAT/U.S., and the Coast Guard Auxiliary include information on the safe operation of personal watercraft in all recreational boating courses.

The CDC found that 7 percent of PWC injuries were to persons 14 years and younger and suggested that parental or adult supervision of children using PWC would be appropriate. The Safety Board notes that several States (for example, Georgia, Minnesota, and Utah) require adult supervision; however, the Safety Board's analysis could not determine if supervision affected accident risk. Accidents in the Safety Board's study did occur to young operators who were within sight distance of adults or who had adult passengers on board the PWC. Although it is reasonable to believe that supervision reduces risky behavior, it cannot prevent accidents; consequently, the Safety Board views designation of a minimum operator age and training requirements as better approaches.

It was the CDC's opinion that protection for the face and extremities is warranted, but it is not clear what kind of protection currently available is appropriate for use in water recreation. The CDC advises, and the Safety Board agrees, that more research is needed to determine the appropriate methods for head and extremity protection.

Much of the understanding of injury causation comes from highway accident investigations. When PWC are compared to those vehicles, it is clear that PWC riders do not occupy an enclosed, structurally protected driving space. The vessel is not designed to restrain riders from being ejected (as occurred in 11 percent of the Board's 1997 accident sample), nor does the vessel surround the rider to absorb the forces of impact during collision with objects or other vessels. The physical forces of the accident vessels are transferred directly to the rider upon contact.

It is evident from accident and injury data that PWC riders involved in accidents are susceptible to injury; 39.4 percent of accident-involved operators in the 1997 accidents examined by the Safety Board sustained injury. Further, PWC riders account for over 41 percent of Coast Guard-recorded injuries to all recreational boaters in 1996 (1,831 of 4,427). Because 4 out of 10 accident-involved operators in the 1997 PWC accidents examined by the Safety Board were injured, the Safety Board concludes that there appears to be a high risk of injury associated with PWC operations. The Safety Board's analysis specifically identified a large number of injuries to areas of the head and lower extremities, and this finding is consistent with other research of PWC-related injury. The Safety Board believes that PWC manufacturers should evaluate personal watercraft designs and make changes to improve operator control and to help prevent personal injuries. Consider items such as off-throttle steering, braking, and padded handlebars, and operator equipment such as personal flotation devices and helmets.

¹⁶ The CDC stated that right-of-way guidelines currently in place for boat operators should be considered for extension to PWC users. A review by Safety Board staff for this study indicates that all States do require PWC to comply with the right-of-way guidelines that apply to recreational boats.

Boating Safety Standards

Manufacturers of inboard and outboard motorboats must meet safety standards for the manufacture of boats and associated equipment (33 CFR Part 183), including requirements for certification and labeling (Part 181) and defect notification (Part 179). The standards and regulations of Part 183 specifically address capacity, loading, flotation, electrical systems, fuel systems, and ventilation. In addition to the provisions included in the regulations, many requirements are incorporated by reference.¹⁷

Federal statutes authorize the Coast Guard to issue exemptions from safety standards for manufacturers of boats to which the application of a standard is impractical or unreasonable and when the manufacturer can show that granting the exemption will not adversely affect boating safety.¹⁸ Manufacturers must petition the Coast Guard for exemption from safety standards. The Coast Guard has granted exemptions to every petition received from PWC manufacturers, and for each model for which an exemption was requested.¹⁹

Personal watercraft, as a vessel design category, cannot comply with the Coast Guard standards as currently written, and thus the exemptions from the existing standards are unavoidable. The following examples are provided to explain why PWC need exemptions from the existing standards:

- The safe loading standard, as currently written, is based on the assumption that water will flow into the vessel. If there is no load area into which water will flow, it is impossible to test a vessel in accordance with the safe loading standard; safe loading standards determine the weight limits appropriate for a particular vessel, and, by correlation, determine the person capacity.²⁰

¹⁷ Information incorporated by reference (as listed in Paragraph 183.5) includes recommended practices developed by the Institute of Electrical and Electronics Engineers, Inc., electrical code requirements of the National Fire Protection Association, recommended practices of the Society of Automotive Engineers, Inc., and the Underwriters Laboratory, Inc.

¹⁸ The Coast Guard's authorization was described in correspondence dated January 17, 1995, between U.S. Coast Guard Chief, Recreational Boating Product Assurance Branch, and the Chairman of the National Association of State Boating Law Administrators.

¹⁹ The Coast Guard has issued exemptions from its standards for both inboard- and outboard-powered personal watercraft, hovercraft, airboats, raceboats, and submarines.

²⁰ To receive an exemption, PWC manufacturers provide the Coast Guard with test data to show adequate flotation, boat weight and passenger capacity, and the amount of flotation material installed. Based on this information, the Coast Guard determines whether each PWC model contains sufficient flotation to meet the intent of the standard.

- In addition, if weight capacities cannot be determined in accordance with the safe loading standard, it becomes difficult to determine the required volume of flotation material for compliance with the flotation standard,²¹ thus PWC are also exempted from the flotation standard and from requirements for labeling the capacity of the PWC.²²
- Manufacturers of personal watercraft have also received exemptions from electrical and fuel systems standards and from the requirement for powered ventilation in the ventilation standard. The manufacturers' main justification for requesting these exemptions is that PWC design features minimize the possibility of arcing or sparks; specifically, fuel systems minimize the possibility of fuel vapor leakage, and the comparatively smaller size of the engine compartment compared to larger, more conventional boats limit the air supply and the PWC's ability to support combustion. Because PWC have a tendency to capsize and could take on water through their blowers, the powered ventilation standards, as currently written, cannot be applied.

Voluntary industry construction standards have been developed by the Society of Automotive Engineers (SAE) and the International Standards Organization (ISO); these standards are similar to the Coast Guard boat standards but are specific to PWC. SAE's Personal Watercraft Subcommittee of the Marine Technical Committee has developed standards to address PWC flotation (Recommendation Practice J1973), electrical systems (J2120), fuel systems (J2046), and ventilation (J2034). In its rationale for issuing these standards, the SAE recognized that PWC cannot comply with the Coast Guard regulations for conventional boat system designs, and it recognized the specific differences that affect PWC system requirements. For example, the SAE fuel system standard is more stringent than Coast Guard requirements; the SAE standard requires that the PWC system not leak liquid fuel into the vessel when rotated through a 180-degree roll in either direction or overturned through 90 degrees of pitch in either direction. The Safety Board recognizes that industry representatives serve on SAE committees and that all of the major PWC manufacturers voluntarily comply with the SAE standards. Industry representatives have also contributed to the development of ISO standards, which are similar to SAE standards.

In May 1997, NASBLA asked the Coast Guard to consider developing standards for PWC. Based on this request, the Coast Guard noted the similarities between SAE and ISO standards and specifically identified the differences between SAE standards and the existing safety standards as defined in Part 183. In October 1997, the Coast Guard's Boating Safety Advisory Committee requested the Coast Guard to review how manufacturers determine capacity on multiple-occupant rated PWC models—how the lack of an industry-wide standard for determining and displaying "persons capacity" impacts rider safety, including consideration of accident data.

²¹ Basic flotation, as applied to inboard and inboard-outdrive boats, requires sufficient flotation material so that if the vessel capsizes or swamps, the boat will remain floating with some portion of its hull above the surface of the water.

²² Manufacturers are considering the use of a capacity label that would indicate the rated person capacity. The proposed capacity marking label would state that the vessel complies with ISO 13590 of the International Standards Organization and that it is certified by the National Marine Manufacturers Association.

Coast Guard staff, in a meeting with Safety Board staff on April 10, 1998, indicated that there was no compelling statistical evidence that PWC problems warrant modifying existing safety standards for flotation (capacity), electrical system, fuel systems, and ventilation.

The Safety Board notes that the Coast Guard's four standards were developed, in part, to address the most serious safety concerns of traditional motorboats: drowning, fire, and explosion. The Safety Board's study clearly points out, however, that these are not the most prevalent safety concerns for PWC. PWC, as previously mentioned, is the only type of recreational vessel for which the leading cause of death is not drowning. Also, in traditional boats, falling overboard and swamping would be considered emergency situations; however, for PWC, these are expected events and, consequently, PWC are designed and constructed to different design criteria than traditional boats.

The Safety Board questions the need for the Coast Guard to continue the exemption process for PWC, particularly given that industry standards exist (and in certain areas are more stringent than the Coast Guard's), that there is voluntary compliance with the standards, and that the standards appear to provide an equivalent level of safety as envisioned by the Coast Guard standards. The Safety Board concludes that the existing process of exempting PWC from standards that were defined for conventional boats is an inappropriate method for certifying the safety and seaworthiness of PWC. In the Safety Board's opinion, the exemption process does little in terms of evaluating possible safety risks that may be associated with the unique operating characteristics of PWC. The Safety Board is aware that the Coast Guard is working with the PWIA to incorporate SAE standards by reference as an alternate method of compliance with existing Federal regulations. The fact that PWC do not "fit" existing standards for open-hull vessels does not release the Coast Guard from its responsibility to regulate the safety of these vessels, particularly since personal watercraft now represent more than one-third of the new recreational boats sold. The Safety Board is recommending, therefore, that the Coast Guard eliminate the existing process of exempting PWC from standards that were defined for conventional boats and believes that the PWC manufacturers should develop, in conjunction with the U.S. Coast Guard, comprehensive standards that are specific to the safety risks of PWC.

The Safety Board notes, however, that industry has voluntarily complied only with those standards that address the existing Coast Guard boating safety standards (flotation, capacity, electrical, fuel, and ventilation) that were established for conventional boats. The Safety Board is concerned that there are other safety issues associated with PWC that warrant attention. The need for improved steering control and prevention of "runaway" PWC once an operator is ejected serve as two prime examples of areas where improvements in design could result in a decrease in accidents.

State marine accident investigators have recognized that steering issues are associated with many PWC accidents. The Safety Board reviewed available accident reports for 1996 and 1997 and, based on narrative information contained in the accident reports, determined that more than 350 (20 percent) of the cases reviewed indicated steering or loss of control problems. Accident reports reviewed for the Safety Board's study highlight problems of operator control

during off-throttle steering situations. Some portion of operator control problems may be attributed to the operating design of personal watercraft.

The narrative report of an accident that occurred in Illinois included the following investigator comment: "She (V1) stated that as they came close, she let off the throttle and then tried to turn but couldn't. She stated that V2 hit her in the side of the Sea-Doo causing a tremendous amount of damage... V2 advised that as she came close to V1 she turned to avoid her, but it didn't turn because she let off of the throttle." The report of a fatal Missouri accident included the following investigator comments: "He did not think that she knew that he was behind her. He said that it was less than a second between when she turned and when he struck her. He let go of the throttle, but it did not help."

On September 10, 1997, NASBLA adopted a resolution (No. 97-3) petitioning the Coast Guard to evaluate off-throttle steering of jet-pump propelled craft and to develop appropriate standards. The Coast Guard issued a grant request in October 1997.²³ The objective of this work will be to identify the most effective of the available and emerging technologies/methodologies in the area of off-throttle steering. As part of the background information in the grant description, the Coast Guard stated: "A large percentage of accidents involving jet-pump propelled craft involve collisions with other craft or fixed objects. Because of the unique relationship between the amount of throttle and steering response on jet-pump propelled craft, there is concern that a sudden loss of engine power—either due to part failure or operator decision—may play a significant role in these collisions." Announcement of the grant award is anticipated in the near future. The Safety Board study data support the need for this research, and an evaluation of PWC steering design is warranted. The Safety Board is concerned that the Coast Guard has not taken a proactive role in assessing the safety risks of PWC. Therefore, the Safety Board is recommending that within 2 years the Coast Guard determine, through research, the feasibility of providing PWC operators more control in an off-throttle steering situation. The Safety Board also believes that the Coast Guard should work with the PWIA to use the results of this research to develop appropriate standards for steering on jet-pump propelled vessels.

Therefore, the National Transportation Safety Board recommends that the manufacturers of personal watercraft (Kawasaki, Yamaha, Polaris, Bombardier, and Arctic Cat, Inc./Tiger Shark):

Evaluate personal watercraft designs and make changes to improve operator control and to help prevent personal injuries. Consider items such as off-throttle steering, braking, and padded handlebars, and operator equipment such as personal flotation devices and helmets. (M-98-85)

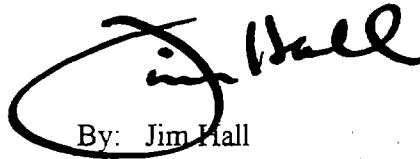
Develop, with the U.S. Coast Guard, comprehensive standards that are specific to the safety risks of personal watercraft. (M-98-86)

²³ Federal Register, Vol. 62, No. 193, dated October 6, 1997, page 52176.

Also as a result of this study, the Safety Board issued safety recommendations to the U.S. Coast Guard, the U.S. Coast Guard Auxiliary, the National Association of State Boating Law Administrators, the Personal Watercraft Industry Association, the U.S. Power Squadrons, BOAT/U.S., and the Governors of the States and Territories.

The National Transportation Safety Board is an independent Federal agency with the statutory responsibility "...to promote transportation safety by conducting independent accident investigations and by formulating safety improvement recommendations" (Public Law 93-633). The Safety Board is vitally interested in any actions taken as a result of its safety recommendations and would appreciate a response from you regarding action taken or contemplated with respect to the recommendations in this letter. Please refer to Safety Recommendations M-98-85 and -86 in your reply.

Chairman HALL, Vice Chairman FRANCIS, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in these recommendations.

A handwritten signature in black ink, appearing to read "Jim Hall", is written over a circular stamp. The signature is fluid and cursive.

By: Jim Hall
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National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: June 25, 1998

In reply refer to: M-98-87 through -91

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Personal watercraft (PWC) are a type of recreational boat that has become increasingly popular in recent years. Manufacturers estimate that about 200,000 PWC are sold each year, and more than 1 million are in current operation. PWC now account for more than one-third of the new recreational boat sales in the United States.

Although the overall number of recreational boating fatalities has been declining in recent years, the number of personal watercraft-related fatalities has been increasing. At the time of the National Transportation Safety Board's 1993 recreational boating safety study, there were only 26 personal watercraft fatalities a year, and the Safety Board did not believe that separate consideration of PWC was warranted. However, in 1994, the number of PWC fatalities began to increase noticeably because the number of PWC in operation increased. Preliminary numbers for 1997 indicate 83 PWC fatalities. PWC are the only type of recreational vessel for which the leading cause of fatalities is not drowning; in PWC fatalities, more persons die from blunt force trauma than from drowning. The increase in fatalities and the distinctive way in which fatalities occur prompted the Safety Board to examine the nature of PWC accidents.

The Safety Board initiated a study to more closely examine fatalities and injury in addition to accident characteristics associated with PWC accidents.¹ The study was not designed to estimate how often PWC accidents occur. The Safety Board examined 1,739 PWC accident reports for accidents that occurred during an 18-month period, January 1996 through June 1997. For PWC accidents that occurred between January and June 1997, the Safety Board requested that State marine accident investigators provide the Safety Board with copies of their accident reports and complete a supplemental questionnaire prepared by the Safety Board specifically for this study. The goal of the supplemental questionnaire was to obtain additional information concerning the accident characteristics and details concerning personal injury that have not

¹ National Transportation Safety Board. 1998. Personal Watercraft Safety. Safety Study NTSB/SS-98/01. Washington, DC.

previously been available from State boating accident reports. State accident reports and supplemental information were the sources of the Safety Board's accident information.

For the January-June 1997 period, the Safety Board received boating accident reports and questionnaire responses from 37 participating States and Territories. Boating accident reports were not always accompanied by supplemental questionnaires. Also, because of concerns over personal privacy issues, five States² did not provide the Safety Board with copies of their boating accident reports but did provide supplemental questionnaires. Consequently, the boating accident reports and the supplemental questionnaires represent two different but substantially overlapping sets of data, which contain information on a total of 814 PWC accidents involving 1,218 operators.

The Safety Board also reviewed State reports of PWC accidents that occurred in 1996. A total of 49 States and Territories provided either copies of their boating accident report forms, automated boating accident report database files, or summary information for 1996 and/or 1997.

Because the States voluntarily provided the Safety Board with accident reports and supplemental questionnaire information, and because of the incomplete nature of much of the information, the Safety Board does not claim that the results of the study are representative of all PWC accidents. The Safety Board analyzed 814 (one-third) of the 1997 reported accidents and examined all of the data for the 1996 reported accidents. Consequently, the Board believes that a substantial number of accidents was available to identify the most important safety issues associated with PWC accidents. Further, the Safety Board's analysis did not show any biases in the types of accidents in the half-year of 1997 accidents compared to the full year of 1996 accidents. The Safety Board's interest in truncating the data collection period to 6 months was based on a goal of providing the results of this study prior to the 1998 summer boating season.

Based on the analysis of the data reviewed, the safety issues discussed in the Safety Board's report include the following: protecting personal watercraft riders from injury, operator experience and training, and boating safety standards. The study also addressed the need for recreational boating exposure data.

Exposure Data

Riding time is an important factor in interpreting accident and injury information. To accurately compare PWC accidents to accidents involving other types of recreational boats, it is necessary to quantify the usage time by vessel type. If PWC are used more often than other types of boats, then their exposure time for incurring an accident would be higher.

A national boating survey conducted in 1988-89 by the American Red Cross occurred at a time when PWC were just becoming popular. The survey reported 45 passenger hours per year

² California, Delaware, Nevada, Washington, and the Territory of Puerto Rico.

for PWC compared to 117 passenger hours per year for all recreational boats.³ Since 1989, the number of PWC has increased nearly six-fold and now account for 36 percent of new boat sales. The dramatic rise in popularity of PWC demonstrates that boating practices have changed in the intervening years since the Red Cross survey was completed and highlights the need for a current, unbiased measure of boat usage for all recreational boat types (for example, personal watercraft, sailboat, motorboat, canoe, and rowboat).

A PWC owner survey commissioned by the Personal Watercraft Industry Association (PWIA) documented a high usage time for PWC: an average of 7 days per month during the 1995 season.⁴ Another source of information about usage, the National Recreational Boating Needs Assessment Survey, was prepared in response to 1997 Congressional hearings for the reauthorization of transportation trust funds.⁵ Because the survey data were intended to be one tool to help in determining the allocation of monies derived from gasoline tax, the survey collected information only about motorboats, without an interest for other categories of recreational boats. The survey was conducted through telephone interviews to 1,000 U.S. households; the results were based on information provided by the 266 that were boating households. (By comparison, the national boating survey conducted in 1989 by the American Red Cross surveyed 5,031 households). The National Recreational Boating Needs Assessment Survey, which distinguished only two categories for motorboat usage (motorboats 18 feet or less and motorboats 19 feet or more), found that motorboats 18 feet or less were used an average of 30 days a year and 5 hours a day (150 hours per year).

Estimates of usage time specifically comparing PWC and outboard motorboats were prepared by industry in 1996 and submitted to the Environmental Protection Agency (EPA) in support of rulemaking for marine engines.⁶ Annual time of use for PWC was 77.3 hours per year compared to 34.8 hours per year for outboard vessels; using these measures of usage time, the exposure factor for PWC was 2.22 times higher than for outboard vessels. This is a substantially different estimate than the one developed by the National Recreational Boating Needs Assessment Survey. Given the changes in boating practices since the 1989 Red Cross boating survey and the differences in estimates of PWC usage reported by industry, the Safety Board concludes that a

³ U.S. Department of Transportation, United States Coast Guard. 1991. American Red Cross national boating survey: a study of recreational boats, boaters, and accidents in the United States. Washington, DC; grant agreement 1801-82. 350 p.

⁴ Bowe Marketing Research. 1996. PWIA owner usage, attitude, and demographic research. Survey of PWC owners commissioned by the PWIA and presented at the PWIA Board of Directors meeting July 23, 1996. The survey response rate (2,800 replies from 11,500 mailed surveys) represents 26 percent of the deliverable mail-outs. The survey results did not indicate the proportion of rental agents included in the survey.

⁵ Hagler Bailly, Inc. 1997. The national recreational boating needs assessment survey. Final report prepared for the International Association of Fish and Wildlife Agencies, Washington, DC. 36 p., plus appendixes. Project funded by the U.S. Fish and Wildlife Service, Washington, DC; Sportfish Restoration Program grant agreement 14-48-98210-97-G067.

⁶ Submission by Mercury Marine in response to EPA request for comments concerning Rule—Air pollution control, gasoline spark-ignition marine engines. Federal Register, Vol. 61, No. 194, dated October 4, 1996, page 52088.

rate of injury for PWC in relation to all recreational boat types cannot be determined because accurate information on usage by boat type is not available.

The Coast Guard has recognized the need for boat usage time and exposure data, and in 1997 issued a notice seeking application for grants to conduct a comprehensive national boating survey.⁷ The Safety Board commends the Coast Guard in recognizing this need and urges completion of the survey. Once this effort is completed, there is a continuing need to accurately assess recreational boat use. The Safety Board believes, therefore, that the U.S. Coast Guard should collect recreational boating exposure data such as "operational use time" or "vessel running time" and update this information on an annual basis or conduct periodic surveys.

Operator Experience and Training

For the January–June 1997 period, experience was reported for half (613) of the 1,218 PWC operators involved in the accidents.⁸ Nearly a third of all operators (32 percent) reported that they had operated a PWC between zero and 10 times prior to the accident: 86 never, 75 once, and 225 between 2 and 10 times. PWC operators with experience of more than 10 times accounted for 18 percent (220 of the 1,218 operators).

The Safety Board's analysis of the 1997 State boating accident reports showed that 87 percent of the PWC operators had received no boating instruction.⁹ The NTSB supplemental questionnaire submitted by the States indicated a similar proportion: 84 percent had completed no type of boating instruction.¹⁰ The need for boating instruction was addressed in the Safety Board's 1993 safety study of recreational boating; 81 percent of the operators involved in fatal accidents in that study had received no boating safety instruction.¹¹ A review of 1996 Coast Guard boating statistics also illustrates that recreational boaters have a low exposure to safety education. Of the 709 recreational boating fatalities, educational experience was known for 340: 50 (15 percent) had received operator education, and 290 (85 percent) were known not to have received operator education. Data for 1991 through 1996 reflect similar proportions regarding the fatally injured operators who had received boating safety education.

⁷ Federal Register, Vol. 62, No. 193, dated October 6, 1997, page 52175.

⁸ The Safety Board recognizes that the data on this topic are based on self-report and may be an overestimate of the number of PWC operators with experience and training.

⁹ Training information was reported for 471 of the 1,218 PWC operators: 413 had none, and 58 had completed State courses, Coast Guard Auxiliary training, Power Squadron training, Red Cross training, or other (military) training. The duration of the reported training or quality of the course content may have varied.

¹⁰ Responses to a boater education question that was included on the supplemental questionnaire were reported for 712 of the 1,218 operators; of those responding, 600 (84 percent) had no training.

¹¹ National Transportation Safety Board. 1993. Recreational boating safety. Safety Study NTSB/SS-93/01. Washington, DC. 104 p. The Safety Board's experience indicates that boating accidents involving a fatality are more likely to be reported than those involving less serious injury. Fatal accidents are also better documented. The Board used fatal accidents to illustrate the proportion of operators who had received boating education because it had greater confidence in the boating education data from that subset than from all accidents.

On October 23, 1997, the Coast Guard issued a notice in the Federal Register requesting comments on a proposed Federal requirement for education in recreational boating. On March 20, 1998, the Coast Guard extended the comment period until May 29, 1998.¹² The Safety Board submitted comments supporting the need for operator education and training for recreational boaters and PWC operators, and reiterating the conclusions and recommendations of its 1993 study on recreational boating safety. The Board's comments noted that the lack of education reported for the PWC operators in the current study provides further support for the need for education of recreational boat and PWC operators.

The National Association of State Boating Law Administrators (NASBLA), BOAT/U.S., the Coast Guard Auxiliary, the U.S. Power Squadrons, the National Safe Boating Council, and the National Water Safety Congress support recreational boating education. NASBLA's Education Committee has a review process designed to standardize training information by approving boating safety curriculums. NASBLA has also developed a model PWC boating course. This course outline may be used by the individual States to pattern the courses they develop, and it serves as a guide to educational organizations that work within the local communities to provide training. In addition to NASBLA's education efforts, the PWIA has also been developing model PWC education requirements. PWIA advocates mandatory education for PWC operators and has mandatory education as an element of its model legislation.

PWC manufacturers provide safety information in printed and video formats with every PWC sold, and dealers are asked to review these safety techniques with customers. The PWIA has also developed classroom material used in several State safety education courses. One manufacturer recently introduced a PWC training program that requires dealers to deliver a boating safety presentation (video and law review) to all purchasers of new PWC.¹³ The product cannot be warranty-registered until the customer receives the information. The Safety Board commends industry efforts to provide PWC owners with point-of-purchase education and training. However, this point-of-purchase information may not reach relatives and friends of the PWC owner who may use the vessel. In its 1993 study on recreational boating, the Safety Board recommended that each State

Implement minimum recreational boating safety standards to reduce the number and severity of accidents; consider requirements such as mandatory use of personal flotation devices for children, demonstration of operator knowledge of safe boating rules and skills, and operator licensing. (M-93-1).¹⁴

Although some progress has been made in responding to the Safety Board's recommendation, as shown by the 4 States that now require boater certification and the 20 that mandate boating education, the Safety Board continues to believe that if more recreational boaters

¹² Federal Register, Vol. 63, No. 54, dated March 20, 1998, page 13585.

¹³ Polaris Industries, Inc.

¹⁴ Safety Recommendation M-93-1 has been classified "Closed—Acceptable Action" for 7 States, "Open—Acceptable Response" for 28 States, "Open—Response Received" for 4 States, "Open—Awaiting Response" for 9 States, and "Closed—Unacceptable Action" for 4 States.

were trained, the number of persons killed and injured in recreational boating accidents, including those involving PWC, would be reduced. Therefore, the Safety Board is reiterating Safety Recommendation M-93-1 in the report of its PWC study. Because two-thirds of PWC owners also owned a powerboat prior to purchasing a PWC,¹⁵ it is reasonable to believe that powerboat operators taking a recreational boating education course may someday be PWC owners or operators. To reach the maximum number of persons who may operate a privately owned PWC, recreational boating education courses should provide some level of PWC training. This is not to say that all boaters should take a PWC course, but rather that all recreational boating courses should address PWC safety issues. Therefore, the Safety Board is recommending that the States, the Coast Guard Auxiliary, BOAT/U.S., the U.S. Power Squadrons, and NASBLA include information on the safe operation of PWC in all recreational boating courses.

Accident data showed that operators of rented PWC in the study sample had less PWC experience than did operators of privately owned personal watercraft. Considering the unique operating characteristics of PWC, this lack of experience creates a safety risk. Given that the percentage of PWC accidents that occur within the first hour was almost twice as high for rented PWC as for nonrented PWC (73 percent compared to 39 percent), that half of the accident-involved rental operators had limited or no experience on a PWC, and that about two-thirds of accident-involved PWC renters had not had to demonstrate their ability to operate the vessel, the Safety Board is recommending that States should enact or revise their recreational boating laws, as necessary, to require rental businesses to provide safety instruction training to all persons who operate rented PWC; all the operators should be required to demonstrate their ability to operate and control PWC. The Safety Board also believes that the Coast Guard, in conjunction with NASBLA and the PWIA, should develop a checklist for boat rental businesses to use for evaluating a person's ability to operate a personal watercraft.

Boating Safety Standards

Manufacturers of inboard and outboard motorboats must meet safety standards for the manufacture of boats and associated equipment (33 CFR Part 183), including requirements for certification and labeling (Part 181) and defect notification (Part 179). The standards and regulations of Part 183 specifically address capacity, loading, flotation, electrical systems, fuel systems, and ventilation. In addition to the provisions included in the regulations, many requirements are incorporated by reference.¹⁶

¹⁵ Bowe Marketing Research. 1996. PWIA owner usage, attitude, and demographic research. Survey of PWC owners commissioned by the PWIA and presented at the PWIA Board of Directors meeting July 23, 1996.

¹⁶ Information incorporated by reference (as listed in Paragraph 183.5) includes recommended practices developed by the Institute of Electrical and Electronics Engineers, Inc., electrical code requirements of the National Fire Protection Association, recommended practices of the Society of Automotive Engineers, Inc., and the Underwriters Laboratory, Inc.

Federal statutes authorize the Coast Guard to issue exemptions from safety standards for manufacturers of boats to which the application of a standard is impractical or unreasonable and when the manufacturer can show that granting the exemption will not adversely affect boating safety.¹⁷ Manufacturers must petition the Coast Guard for exemption from safety standards. The Coast Guard has granted exemptions to every petition received from PWC manufacturers, and for each model for which an exemption was requested.¹⁸

Personal watercraft, as a vessel design category, cannot comply with the Coast Guard standards as currently written, and thus the exemptions from the existing standards are unavoidable. The following examples are provided to explain why PWC need exemptions from the existing standards:

- The safe loading standard, as currently written, is based on the assumption that water will flow into the vessel. If there is no load area into which water will flow, it is impossible to test a vessel in accordance with the safe loading standard; safe loading standards determine the weight limits appropriate for a particular vessel, and, by correlation, determine the person capacity.¹⁹
- In addition, if weight capacities cannot be determined in accordance with the safe loading standard, it becomes difficult to determine the required volume of flotation material for compliance with the flotation standard,²⁰ thus PWC are also exempted from the flotation standard and from requirements for labeling the capacity of the PWC.²¹

¹⁷ The Coast Guard's authorization was described in correspondence dated January 17, 1995, between U.S. Coast Guard Chief, Recreational Boating Product Assurance Branch, and the Chairman of the National Association of State Boating Law Administrators.

¹⁸ The Coast Guard has issued exemptions from its standards for both inboard- and outboard-powered personal watercraft, hovercraft, airboats, raceboats, and submarines.

¹⁹ To receive an exemption, PWC manufacturers provide the Coast Guard with test data to show adequate flotation, boat weight and passenger capacity, and the amount of flotation material installed. Based on this information, the Coast Guard determines whether each PWC model contains sufficient flotation to meet the intent of the standard.

²⁰ Basic flotation, as applied to inboard and inboard-outdrive boats, requires sufficient flotation material so that if the vessel capsizes or swamps, the boat will remain floating with some portion of its hull above the surface of the water.

²¹ Manufacturers are considering the use of a capacity label that would indicate the rated person capacity. The proposed capacity marking label would state that the vessel complies with ISO 13590 of the International Standards Organization and that it is certified by the National Marine Manufacturers Association.

- Manufacturers of personal watercraft have also received exemptions from electrical and fuel systems standards and from the requirement for powered ventilation in the ventilation standard. The manufacturers' main justification for requesting these exemptions is that PWC design features minimize the possibility of arcing or sparks; specifically, fuel systems minimize the possibility of fuel vapor leakage, and the comparatively smaller size of the engine compartment compared to larger, more conventional boats limit the air supply and the PWC's ability to support combustion. Because PWC have a tendency to capsize and could take on water through their blowers, the powered ventilation standards, as currently written, cannot be applied.

Voluntary industry construction standards have been developed by the Society of Automotive Engineers (SAE) and the International Standards Organization (ISO); these standards are similar to the Coast Guard boat standards but are specific to PWC. SAE's Personal Watercraft Subcommittee of the Marine Technical Committee has developed standards to address personal watercraft flotation (Recommendation Practice J1973), electrical systems (J2120), fuel systems (J2046), and ventilation (J2034). In its rationale for issuing these standards, the SAE recognized that PWC cannot comply with the Coast Guard regulations for conventional boat system designs, and it recognized the specific differences that affect PWC system requirements. For example, the SAE fuel system standard is more stringent than Coast Guard requirements; the SAE standard requires that the PWC system not leak liquid fuel into the vessel when rotated through a 180-degree roll in either direction or overturned through 90 degrees of pitch in either direction. The Safety Board recognizes that industry representatives serve on SAE committees and that all of the major PWC manufacturers voluntarily comply with the SAE standards. Industry representatives have also contributed to the development of ISO standards, which are similar to SAE standards.

In May 1997, NASBLA asked the Coast Guard to consider developing standards for PWC. Based on this request, the Coast Guard noted the similarities between SAE and ISO standards and specifically identified the differences between SAE standards and the existing safety standards as defined in Part 183. In October 1997, the Coast Guard's Boating Safety Advisory Committee requested the Coast Guard to review how manufacturers determine capacity on multiple-occupant rated PWC models—how the lack of an industry-wide standard for determining and displaying "persons capacity" impacts rider safety, including consideration of accident data. Coast Guard staff, in a meeting with Safety Board staff on April 10, 1998, indicated that there was no compelling statistical evidence that PWC problems warrant modifying existing safety standards for flotation (capacity), electrical system, fuel systems, and ventilation.

The Safety Board notes that the Coast Guard's four standards were developed, in part, to address the most serious safety concerns of traditional motorboats: drowning, fire, and explosion. The Safety Board's study clearly points out, however, that these are not the most prevalent safety concerns for PWC. PWC, as previously mentioned, is the only type of recreational vessel for which the leading cause of death is not drowning. Also, in traditional boats, falling overboard and swamping would be considered emergency situations; however, for PWC, these are expected

events and, consequently, PWC are designed and constructed to different design criteria than traditional boats.

The Safety Board questions the need for the Coast Guard to continue the exemption process for PWC, particularly given that industry standards exist (and in certain areas are more stringent than the Coast Guard's), that there is voluntary compliance with the standards, and that the standards appear to provide an equivalent level of safety as envisioned by the Coast Guard standards. The Safety Board concludes that the existing process of exempting PWC from standards that were defined for conventional boats is an inappropriate method for certifying the safety and seaworthiness of PWC. In the Safety Board's opinion, the exemption process does little in terms of evaluating possible safety risks that may be associated with the unique operating characteristics of PWC. The Safety Board is aware that the Coast Guard is working with the PWIA to incorporate SAE standards by reference as an alternate method of compliance with existing Federal regulations. The fact that PWC do not "fit" existing standards for open-hull vessels does not release the Coast Guard from its responsibility to regulate the safety of these vessels, particularly since personal watercraft now represent more than one-third of the new recreational boats sold. The Safety Board believes, therefore, that the Coast Guard should eliminate the existing process of exempting PWC from standards that were defined for conventional boats and develop, with the PWC manufacturers, comprehensive standards that are specific to the safety risks of PWC.

The Safety Board notes, however, that industry has voluntarily complied only with those standards that address the existing Coast Guard boating safety standards (flotation, capacity, electrical, fuel, and ventilation) that were established for conventional boats. The Safety Board is concerned that there are other safety issues associated with PWC that warrant attention. The need for improved steering control and prevention of "runaway" PWC once an operator is ejected serve as two prime examples of areas where improvements in design could result in a decrease in accidents.

State marine accident investigators have recognized that steering issues are associated with many PWC accidents. The Safety Board reviewed available accident reports for 1996 and 1997 and, based on narrative information contained in the accident reports, determined that more than 350 (20 percent) of the cases reviewed indicated steering or loss of control problems. Accident reports reviewed for the Safety Board's study highlight problems of operator control during off-throttle steering situations. Some portion of operator control problems may be attributed to the operating design of personal watercraft.

The narrative report of an accident that occurred in Illinois included the following investigator comment: "She (V1) stated that as they came close, she let off the throttle and then tried to turn but couldn't. She stated that V2 hit her in the side of the Sea-Doo causing a tremendous amount of damage.... V2 advised that as she came close to V1 she turned to avoid her, but it didn't turn because she let off of the throttle." The report of a fatal Missouri accident included the following investigator comments: "He did not think that she knew that he was behind her. He said that it was less than a second between when she turned and when he struck her. He let go of the throttle, but it did not help."

On September 10, 1997, NASBLA adopted a resolution (No. 97-3) petitioning the Coast Guard to evaluate off-throttle steering of jet-pump propelled craft and to develop appropriate standards. The Coast Guard issued a grant request in October 1997.²² The objective of this work will be to identify the most effective of the available and emerging technologies/methodologies in the area of off-throttle steering. As part of the background information in the grant description, the Coast Guard stated: "A large percentage of accidents involving jet-pump propelled craft involve collisions with other craft or fixed objects. Because of the unique relationship between the amount of throttle and steering response on jet-pump propelled craft, there is concern that a sudden loss of engine power—either due to part failure or operator decision—may play a significant role in these collisions." Announcement of the grant award is anticipated in the near future. The Safety Board study data support the need for this research, and an evaluation of PWC steering design is warranted. The Safety Board is concerned that the Coast Guard has not taken a proactive role in assessing the safety risks of PWC. Therefore, the Safety Board believes that within 2 years the Coast Guard should determine, through research, the feasibility of providing PWC operators more control in an off-throttle steering situation. The Safety Board also believes that the Coast Guard should work with the PWIA to use the results of this research to develop appropriate standards for steering on jet-pump propelled vessels.

Therefore, the National Transportation Safety Board recommends that the U.S. Coast Guard:

Eliminate the existing process of exempting personal watercraft from standards that were defined for conventional boats and develop, with the personal watercraft manufacturers, comprehensive standards that are specific to the risks of personal watercraft. (M-98-87)

Determine within 2 years, through research, the feasibility of providing personal watercraft operators more control in an off-throttle steering situation. (M-98-88)

Work with the Personal Watercraft Industry Association to use the results of off-throttle steering research described in Safety Recommendation M-98-88 to develop appropriate standards for steering on jet-pump propelled vessels. (M-98-89)

Develop, in conjunction with the National Association of State Boating Law Administrators and the Personal Watercraft Industry Association, a checklist for boat rental businesses to use for evaluating a person's ability to operate a personal watercraft. (M-98-90)

Collect recreational boating exposure data such as "operational use time" or "vessel running time" and update this information on an annual basis or conduct periodic surveys. (M-98-91)

²² Federal Register, Vol. 62, No. 193, dated October 6, 1997, page 52176.

Also as a result of this study, the Safety Board issued safety recommendations to the manufacturers of personal watercraft (Kawasaki, Yamaha, Polaris, Bombardier, and Arctic Cat, Inc./Tiger Shark), the U.S. Coast Guard Auxiliary, the National Association of State Boating Law Administrators, the Personal Watercraft Industry Association, the U.S. Power Squadrons, BOAT/U.S., and the Governors of the States and Territories.

Chairman HALL, Vice Chairman FRANCIS, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in these recommendations.

A handwritten signature in black ink, appearing to read "Jim Hall". The signature is written in a cursive style with a large, stylized "J" and "H".

By: Jim Hall
Chairman



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: June 25, 1998

In reply refer to: M-98-92

Commodore Everette L. Tucker, Jr.
National Commodore (NACO)
U.S. Coast Guard Auxiliary
610 Allen Mill Road
Yorktown, Virginia 23692-2238

Personal watercraft (PWC) are a type of recreational boat that has become increasingly popular in recent years. Manufacturers estimate that about 200,000 PWC are sold each year, and more than 1 million are in current operation. PWC now account for more than one-third of the new recreational boat sales in the United States.

Although the overall number of recreational boating fatalities has been declining in recent years, the number of personal watercraft-related fatalities has been increasing. At the time of the National Transportation Safety Board's 1993 recreational boating safety study, there were only 26 personal watercraft fatalities a year, and the Safety Board did not believe that separate consideration of PWC was warranted. However, in 1994, the number of PWC fatalities began to increase noticeably because the number of PWC in operation increased. Preliminary numbers for 1997 indicate 83 PWC fatalities. PWC are the only type of recreational vessel for which the leading cause of fatalities is not drowning; in PWC fatalities, more persons die from blunt force trauma than from drowning. The increase in fatalities and the distinctive way in which fatalities occur prompted the Safety Board to examine the nature of PWC accidents.

The Safety Board initiated a study to more closely examine fatalities and injury in addition to accident characteristics associated with PWC accidents.¹ The study was not designed to estimate how often PWC accidents occur. The Safety Board examined 1,739 PWC accident reports for accidents that occurred during an 18-month period, January 1996 through June 1997. For PWC accidents that occurred between January and June 1997, the Safety Board requested that State marine accident investigators provide the Safety Board with copies of their accident reports and complete a supplemental questionnaire prepared by the Safety Board specifically for this study. The goal of the supplemental questionnaire was to obtain additional information

¹ National Transportation Safety Board. 1998. Personal Watercraft Safety. Safety Study NTSB/SS-98/01. Washington, DC.

concerning the accident characteristics and details concerning personal injury that have not previously been available from State boating accident reports. State accident reports and supplemental information were the sources of the Safety Board's accident information.

For the January-June 1997 period, the Safety Board received boating accident reports and questionnaire responses from 37 participating States and Territories. Boating accident reports were not always accompanied by supplemental questionnaires. Also, because of concerns over personal privacy issues, five States² did not provide the Safety Board with copies of their boating accident reports but did provide supplemental questionnaires. Consequently, the boating accident reports and the supplemental questionnaires represent two different but substantially overlapping sets of data, which contain information on a total of 814 PWC accidents involving 1,218 operators.

The Safety Board also reviewed State reports of PWC accidents that occurred in 1996. A total of 49 States and Territories provided either copies of their boating accident report forms, automated boating accident report database files, or summary information for 1996 and/or 1997.

Because the States voluntarily provided the Safety Board with accident reports and supplemental questionnaire information, and because of the incomplete nature of much of the information, the Safety Board does not claim that the results of the study are representative of all PWC accidents. The Safety Board analyzed 814 (one-third) of the 1997 reported accidents, and examined all of the data for the 1996 reported accidents. Consequently, the Board believes that a substantial number of accidents was available to identify the most important safety issues associated with PWC accidents. Further, the Safety Board's analysis did not show any biases in the types of accidents in the half-year of 1997 accidents compared to the full year of 1996 accidents. The Safety Board's interest in truncating the data collection period to 6 months was based on a goal of providing the results of this study prior to the 1998 summer boating season.

Based on the analysis of the data reviewed, the safety issues discussed in the Safety Board's report include the following: protecting personal watercraft riders from injury, operator experience and training, and boating safety standards. The study also addresses the need for recreational boating exposure data. The discussion in this letter is limited to operator experience and training.

Operator Experience and Training

Each year, many first-time PWC operators are exposed to the boating environment. In the Safety Board's 1997 sample of PWC accidents, nearly half (48 percent) of the operators of rented PWC had operated a PWC only once or never; 18 percent of the operators of privately owned PWC had previously operated a PWC only once or never. This lack of experience is particularly important for PWC because the vessels have special operating characteristics, such as the loss of

² California, Delaware, Nevada, Washington, and the Territory of Puerto Rico.

control during off-throttle steering and cut-off ("kill") switches activated by the use of safety lanyards to stop the vessel if the operator is ejected, that underscore the need for training.

Operating a PWC requires a high degree of vigilance. Several PWC models can exceed 60 mph, but even at a speed of 40 mph, a PWC travels about 20 yards per second. As speeds increase, the time available to react decreases. PWC are highly maneuverable vessels that can change course quickly while under power, which presents a particular problem when several PWC are traveling together.³ The timeframe for perceptually tracking another PWC can also be quite limited under these conditions. Operators of two PWC traveling at 40 mph on a head-on course will have a response time of 1.3 seconds to travel 50 yards. Even when the vessels are converging on a 45-degree angle, the response time is less than 2 seconds.⁴ The response time must accommodate perceiving the other vessel, deciding which vessel is burdened to comply with rules of the road, determining the risk of collision, and executing a response to alter course. Under these conditions, inexperienced operators who are not aware of navigation rules⁵ that dictate which vessels have the right of way and, therefore, what direction of turn can be expected for vessels on conflicting routes, are faced with split-second decisions.

The Safety Board's analysis of the 1997 State boating accident reports showed that 87 percent of the PWC operators had received no boating instruction.⁶ The NTSB supplemental questionnaire submitted by the States indicated a similar proportion: 84 percent had completed no type of boating instruction.⁷ The need for boating instruction was addressed in the Safety Board's 1993 safety study of recreational boating; 81 percent of the operators involved in fatal accidents in that study had received no boating safety instruction.⁸ A review of 1996 Coast Guard boating statistics also illustrates that recreational boaters have a low exposure to safety education. Of the 709 recreational boating fatalities, educational experience was known for 340: 50 (15 percent) had received operator education, and 290 (85 percent) were known not to have received operator education. Data for 1991 through 1996 reflect similar proportions regarding the fatally injured operators who had received boating safety education.

³ State boating law administrators agree that PWC operations often involve riding close to other PWC.

⁴ 40 mph = 19.5 yd/sec. On a direct course, each vessel traverses 25 yards; on a converging course, each vessel travels 35.35 yards before intersecting.

⁵ PWC are subject to inland navigation rules as stated in USCG COMDTINST M16672.2B, dated August 17, 1990.

⁶ Training information was reported for 471 of the 1,218 PWC operators: 413 had none, and 58 had completed State courses, Coast Guard Auxiliary training, Power Squadron training, Red Cross training, or other (military) training. The duration of the reported training or quality of the course content may have varied.

⁷ Responses to a boater education question that was included on the supplemental questionnaire were reported for 712 of the 1,218 operators; of those responding, 600 (84 percent) had no training.

⁸ National Transportation Safety Board. 1993. Recreational boating safety. Safety Study NTSB/SS-93/01. Washington, DC. 104 p. The Safety Board's experience indicates that boating accidents involving a fatality are more likely to be reported than those involving less serious injury. Fatal accidents are also better documented. The Board used fatal accidents to illustrate the proportion of operators who had received boating education because it had greater confidence in the boating education data from that subset than from all accidents.

Although no State or Territory requires a special boating license to operate a PWC, 16 jurisdictions have special boating education requirements to operate a PWC.⁹ Effective June 23, 1993, PWC operators in Connecticut were required to take a safe handling course to obtain a certificate for PWC operation; there are no exceptions. Mandatory education requirements include 10 hours of basic boating safety and an additional 2.5 hours of instruction concentrating on PWC safety. Even though there has been a substantial increase in the number of PWC operations, there have been no fatalities attributable to PWC operations in Connecticut in the past 10 years. The boating law administrator for Connecticut indicates that accidents and injuries have decreased over the last 5 years. Training is typically offered by the States' marine safety officers. Michigan's marine education program¹⁰ certified 50,554 students in classroom courses in 1996.¹¹ That State also conducts a PWC education/enforcement program that began in 1995; it involves 30 marine officers assigned to PWC patrol who review regulations, discuss safety, and give equipment demonstrations. Even with a growth in PWC operations, that State has seen a decrease in both PWC accidents and fatalities; PWC accidents in Michigan accounted for 45 percent of all boating accidents in 1995 and dropped to 41 percent in 1996.

On October 23, 1997, the Coast Guard issued a notice in the Federal Register requesting comments on a proposed Federal requirement for education in recreational boating. On March 20, 1998, the Coast Guard extended the comment period until May 29, 1998.¹² The Safety Board submitted comments supporting the need for operator education and training for recreational boaters and PWC operators, and reiterating the conclusions and recommendations of its 1993 study on recreational boating safety. The Board's comments noted that the lack of education reported for the PWC operators in the current study provides further support for the need for education of recreational boat and PWC operators.

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⁹ The following States and Territories require PWC education: Colorado, Connecticut, Delaware, Georgia, Idaho, Kansas, Massachusetts, Minnesota, Nevada, Rhode Island, Tennessee, Texas, Utah, Wisconsin, U.S. Virgin Islands, and American Samoa. Nevada requires PWC education only of PWC operators who rent the vessel. (National Association of State Boating Law Administrators. 1997. Reference guide to State boating laws. 3d ed. Lexington, KY (p. 21). 182 p., plus appendixes.)

¹⁰ Michigan's course is only 1 hour long; most States require 6 to 8 hours of classroom instruction.

¹¹ *Small Craft Advisory*. Dec. 1997/Jan. 1998. Lexington, KY: National Association of State Boating Law Administrators; 13(2): 20.

¹² Federal Register, Vol. 63, No. 54, dated March 20, 1998, page 13585.

requirements. PWIA advocates mandatory education for PWC operators and has mandatory education as an element of its model legislation.

PWC manufacturers provide safety information in printed and video formats with every PWC sold, and dealers are asked to review these safety techniques with customers. The PWIA has also developed classroom material used in several State safety education courses. One manufacturer recently introduced a PWC training program that requires dealers to deliver a boating safety presentation (video and law review) to all purchasers of new PWC.¹³ The product cannot be warranty-registered until the customer receives the information. The Safety Board commends industry efforts to provide PWC owners with point-of-purchase education and training. However, this point-of-purchase information may not reach relatives and friends of the PWC owner who may use the vessel. In its 1993 study on recreational boating, the Safety Board recommended that each State

Implement minimum recreational boating safety standards to reduce the number and severity of accidents; consider requirements such as mandatory use of personal flotation devices for children, demonstration of operator knowledge of safe boating rules and skills, and operator licensing. (M-93-1).¹⁴

Although some progress has been made in responding to the Safety Board's recommendation, as shown by the 4 States that now require boater certification and the 20 that mandate boating education, the Safety Board continues to believe that if more recreational boaters were trained, the number of persons killed and injured in recreational boating accidents, including those involving PWC, would be reduced. Therefore, the Safety Board is reiterating Safety Recommendation M-93-1 in the report of its PWC study. Because two-thirds of PWC owners also owned a powerboat prior to purchasing a PWC,¹⁵ it is reasonable to believe that powerboat operators taking a recreational boating education course may someday be PWC owners or operators. To reach the maximum number of persons who may operate a privately owned PWC, recreational boating education courses should provide some level of PWC training. This is not to say that all boaters should take a PWC course, but rather that all recreational boating courses should address PWC safety issues. Therefore, the Safety Board believes that the Coast Guard Auxiliary, the States, BOAT/U.S., the U.S. Power Squadrons, and NASBLA should include information on the safe operation of PWC in all recreational boating courses.

¹³ Polaris Industries, Inc.

¹⁴ Safety Recommendation M-93-1 has been classified "Closed—Acceptable Action" for 7 States, "Open—Acceptable Response" for 28 States, "Open—Response Received" for 4 States, "Open—Awaiting Response" for 9 States, and "Closed—Unacceptable Action" for 4 States.

¹⁵ Bowe Marketing Research. 1996. PWIA owner usage, attitude, and demographic research. Survey of PWC owners commissioned by the PWIA and presented at the PWIA Board of Directors meeting July 23, 1996.

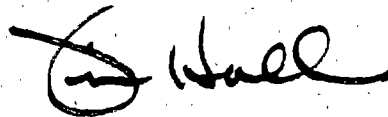
Therefore, the National Transportation Safety Board recommends that the U.S. Coast Guard Auxiliary:

Include information on the safe operation of personal watercraft in all recreational boating courses. (M-98-92)

Also as a result of this study, the Safety Board issued safety recommendations to the manufacturers of personal watercraft (Kawasaki, Yamaha, Polaris, Bombardier, and Arctic Cat, Inc./Tiger Shark), the U.S. Coast Guard, the National Association of State Boating Law Administrators, the U.S. Power Squadrons, BOAT/U.S., the Personal Watercraft Industry Association, and the Governors of the States and Territories.

The National Transportation Safety Board is an independent Federal agency with the statutory responsibility "...to promote transportation safety by conducting independent accident investigations and by formulating safety improvement recommendations" (Public Law 93-633). The Safety Board is vitally interested in any actions taken as a result of its safety recommendations and would appreciate a response from you regarding action taken or contemplated with respect to the recommendation in this letter. Please refer to Safety Recommendation M-98-92 in your reply.

Chairman HALL, Vice Chairman FRANCIS, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in this recommendation.

A handwritten signature in black ink, appearing to read "J. Hall", written in a cursive style.

By: Jim Hall
Chairman



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: June 25, 1998

In reply refer to: M-98-93

Chief Commander Arthur H. Farr
United States Power Squadrons
583 Lake Forest Drive
Bay Village, Ohio 44140

Personal watercraft (PWC) are a type of recreational boat that has become increasingly popular in recent years. Manufacturers estimate that about 200,000 PWC are sold each year, and more than 1 million are in current operation. PWC now account for more than one-third of the new recreational boat sales in the United States.

Although the overall number of recreational boating fatalities has been declining in recent years, the number of personal watercraft-related fatalities has been increasing. At the time of the National Transportation Safety Board's 1993 recreational boating safety study, there were only 26 personal watercraft fatalities a year, and the Safety Board did not believe that separate consideration of PWC was warranted. However, in 1994, the number of PWC fatalities began to increase noticeably because the number of PWC in operation increased. Preliminary numbers for 1997 indicate 83 PWC fatalities. PWC are the only type of recreational vessel for which the leading cause of fatalities is not drowning; in PWC fatalities, more persons die from blunt force trauma than from drowning. The increase in fatalities and the distinctive way in which fatalities occur prompted the Safety Board to examine the nature of PWC accidents.

The Safety Board initiated a study to more closely examine fatalities and injury in addition to accident characteristics associated with PWC accidents.¹ The study was not designed to estimate how often PWC accidents occur. The Safety Board examined 1,739 PWC accident reports for accidents that occurred during an 18-month period, January 1996 through June 1997. For PWC accidents that occurred between January and June 1997, the Safety Board requested that State marine accident investigators provide the Safety Board with copies of their accident reports and complete a supplemental questionnaire prepared by the Safety Board specifically for this study. The goal of the supplemental questionnaire was to obtain additional information

¹ National Transportation Safety Board. 1998. Personal Watercraft Safety. Safety Study NTSB/SS-98/01. Washington, DC.

concerning the accident characteristics and details concerning personal injury that have not previously been available from State boating accident reports. State accident reports and supplemental information were the sources of the Safety Board's accident information.

For the January-June 1997 period, the Safety Board received boating accident reports and questionnaire responses from 37 participating States and Territories. Boating accident reports were not always accompanied by supplemental questionnaires. Also, because of concerns over personal privacy issues, five States² did not provide the Safety Board with copies of their boating accident reports but did provide supplemental questionnaires. Consequently, the boating accident reports and the supplemental questionnaires represent two different but substantially overlapping sets of data, which contain information on a total of 814 PWC accidents involving 1,218 operators.

The Safety Board also reviewed State reports of PWC accidents that occurred in 1996. A total of 49 States and Territories provided either copies of their boating accident report forms, automated boating accident report database files, or summary information for 1996 and/or 1997.

Because the States voluntarily provided the Safety Board with accident reports and supplemental questionnaire information, and because of the incomplete nature of much of the information, the Safety Board does not claim that the results of the study are representative of all PWC accidents. The Safety Board analyzed 814 (one-third) of the 1997 reported accidents, and examined all of the data for the 1996 reported accidents. Consequently, the Board believes that a substantial number of accidents was available to identify the most important safety issues associated with PWC accidents. Further, the Safety Board's analysis did not show any biases in the types of accidents in the half-year of 1997 accidents compared to the full year of 1996 accidents. The Safety Board's interest in truncating the data collection period to 6 months was based on a goal of providing the results of this study prior to the 1998 summer boating season.

Based on the analysis of the data reviewed, the safety issues discussed in the Safety Board's report include the following: protecting personal watercraft riders from injury, operator experience and training, and boating safety standards. The study also addresses the need for recreational boating exposure data. The discussion in this letter is limited to operator experience and training.

Operator Experience and Training

Each year, many first-time PWC operators are exposed to the boating environment. In the Safety Board's 1997 sample of PWC accidents, nearly half (48 percent) of the operators of rented PWC had operated a PWC only once or never; 18 percent of the operators of privately owned PWC had previously operated a PWC only once or never. This lack of experience is particularly important for PWC because the vessels have special operating characteristics, such as the loss of

² California, Delaware, Nevada, Washington, and the Territory of Puerto Rico.

control during off-throttle steering and cut-off ("kill") switches activated by the use of safety lanyards to stop the vessel if the operator is ejected, that underscore the need for training.

Operating a PWC requires a high degree of vigilance. Several PWC models can exceed 60 mph, but even at a speed of 40 mph, a PWC travels about 20 yards per second. As speeds increase, the time available to react decreases. PWC are highly maneuverable vessels that can change course quickly while under power, which presents a particular problem when several PWC are traveling together.³ The timeframe for perceptually tracking another PWC can also be quite limited under these conditions. Operators of two PWC traveling at 40 mph on a head-on course will have a response time of 1.3 seconds to travel 50 yards. Even when the vessels are converging on a 45-degree angle, the response time is less than 2 seconds.⁴ The response time must accommodate perceiving the other vessel, deciding which vessel is burdened to comply with rules of the road, determining the risk of collision, and executing a response to alter course. Under these conditions, inexperienced operators who are not aware of navigation rules⁵ that dictate which vessels have the right of way and, therefore, what direction of turn can be expected for vessels on conflicting routes, are faced with split-second decisions.

The Safety Board's analysis of the 1997 State boating accident reports showed that 87 percent of the PWC operators had received no boating instruction.⁶ The NTSB supplemental questionnaire submitted by the States indicated a similar proportion: 84 percent had completed no type of boating instruction.⁷ The need for boating instruction was addressed in the Safety Board's 1993 safety study of recreational boating; 81 percent of the operators involved in fatal accidents in that study had received no boating safety instruction.⁸ A review of 1996 Coast Guard boating statistics also illustrates that recreational boaters have a low exposure to safety education. Of the 709 recreational boating fatalities, educational experience was known for 340: 50 (15 percent) had received operator education, and 290 (85 percent) were known not to have received operator education. Data for 1991 through 1996 reflect similar proportions regarding the fatally injured operators who had received boating safety education.

³ State boating law administrators agree that PWC operations often involve riding close to other PWC.

⁴ 40 mph = 19.5 yd/sec. On a direct course, each vessel traverses 25 yards; on a converging course, each vessel travels 35.35 yards before intersecting.

⁵ PWC are subject to inland navigation rules as stated in USCG COMDTINST M16672.2B, dated August 17, 1990.

⁶ Training information was reported for 471 of the 1,218 PWC operators: 413 had none, and 58 had completed State courses, Coast Guard Auxiliary training, Power Squadron training, Red Cross training, or other (military) training. The duration of the reported training or quality of the course content may have varied.

⁷ Responses to a boater education question that was included on the supplemental questionnaire were reported for 712 of the 1,218 operators: of those responding, 600 (84 percent) had no training.

⁸ National Transportation Safety Board. 1993. Recreational boating safety. Safety Study NTSB/SS-93/01. Washington, DC. 104 p. The Safety Board's experience indicates that boating accidents involving a fatality are more likely to be reported than those involving less serious injury. Fatal accidents are also better documented. The Board used fatal accidents to illustrate the proportion of operators who had received boating education because it had greater confidence in the boating education data from that subset than from all accidents.

Although no State or Territory requires a special boating license to operate a PWC, 16 jurisdictions have special boating education requirements to operate a PWC.⁹ Effective June 23, 1993, PWC operators in Connecticut were required to take a safe handling course to obtain a certificate for PWC operation; there are no exceptions. Mandatory education requirements include 10 hours of basic boating safety and an additional 2.5 hours of instruction concentrating on PWC safety. Even though there has been a substantial increase in the number of PWC operations, there have been no fatalities attributable to PWC operations in Connecticut in the past 10 years. The boating law administrator for Connecticut indicates that accidents and injuries have decreased over the last 5 years. Training is typically offered by the States' marine safety officers. Michigan's marine education program¹⁰ certified 50,554 students in classroom courses in 1996.¹¹ That State also conducts a PWC education/enforcement program that began in 1995; it involves 30 marine officers assigned to PWC patrol who review regulations, discuss safety, and give equipment demonstrations. Even with a growth in PWC operations, that State has seen a decrease in both PWC accidents and fatalities; PWC accidents in Michigan accounted for 45 percent of all boating accidents in 1995 and dropped to 41 percent in 1996.

On October 23, 1997, the Coast Guard issued a notice in the Federal Register requesting comments on a proposed Federal requirement for education in recreational boating. On March 20, 1998, the Coast Guard extended the comment period until May 29, 1998.¹² The Safety Board submitted comments supporting the need for operator education and training for recreational boaters and PWC operators, and reiterating the conclusions and recommendations of its 1993 study on recreational boating safety. The Board's comments noted that the lack of education reported for the PWC operators in the current study provides further support for the need for education of recreational boat and PWC operators.

The National Association of State Boating Law Administrators (NASBLA), BOAT/U.S., the U.S. Coast Guard Auxiliary, the U.S. Power Squadrons, the National Safe Boating Council, and the National Water Safety Congress support recreational boating education. NASBLA's Education Committee has a review process designed to standardize training information by approving boating safety curriculums. NASBLA has also developed a model PWC boating course. This course outline may be used by the individual States to pattern the courses they develop, and it serves as a guide to educational organizations that work within the local communities to provide training. In addition to NASBLA's education efforts, the Personal Watercraft Industry Association (PWIA) has also been developing model PWC education

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¹¹ *Small Craft Advisory*. Dec. 1997/Jan. 1998. Lexington, KY: National Association of State Boating Law Administrators; 13(2): 20.

¹² Federal Register, Vol. 63, No. 54, dated March 20, 1998, page 13585.

requirements. PWIA advocates mandatory education for PWC operators and has mandatory education as an element of its model legislation.

PWC manufacturers provide safety information in printed and video formats with every PWC sold, and dealers are asked to review these safety techniques with customers. The PWIA has also developed classroom material used in several State safety education courses. One manufacturer recently introduced a PWC training program that requires dealers to deliver a boating safety presentation (video and law review) to all purchasers of new PWC.¹³ The product cannot be warranty-registered until the customer receives the information. The Safety Board commends industry efforts to provide PWC owners with point-of-purchase education and training. However, this point-of-purchase information may not reach relatives and friends of the PWC owner who may use the vessel. In its 1993 study on recreational boating, the Safety Board recommended that each State

Implement minimum recreational boating safety standards to reduce the number and severity of accidents; consider requirements such as mandatory use of personal flotation devices for children, demonstration of operator knowledge of safe boating rules and skills, and operator licensing. (M-93-1).¹⁴

Although some progress has been made in responding to the Safety Board's recommendation, as shown by the 4 States that now require boater certification and the 20 that mandate boating education, the Safety Board continues to believe that if more recreational boaters were trained, the number of persons killed and injured in recreational boating accidents, including those involving PWC, would be reduced. Therefore, the Safety Board is reiterating Safety Recommendation M-93-1 in the report of its PWC study. Because two-thirds of PWC owners also owned a powerboat prior to purchasing a PWC,¹⁵ it is reasonable to believe that powerboat operators taking a recreational boating education course may someday be PWC owners or operators. To reach the maximum number of persons who may operate a privately owned PWC, recreational boating education courses should provide some level of PWC training. This is not to say that all boaters should take a PWC course, but rather that all recreational boating courses should address PWC safety issues. Therefore, the Safety Board believes that the Coast Guard Auxiliary, the States, BOAT/U.S., the U.S. Power Squadrons, and NASBLA should include information on the safe operation of PWC in all recreational boating courses.

¹³ Polaris Industries, Inc.

¹⁴ Safety Recommendation M-93-1 has been classified "Closed—Acceptable Action" for 7 States, "Open—Acceptable Response" for 28 States, "Open—Response Received" for 4 States, "Open—Awaiting Response" for 9 States, and "Closed—Unacceptable Action" for 4 States.

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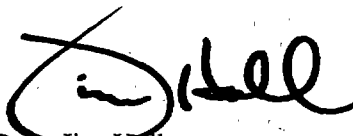
Therefore, the National Transportation Safety Board recommends that the U.S. Power Squadrons:

Include information on the safe operation of personal watercraft in all recreational boating courses. (M-98-93)

Also as a result of this study, the Safety Board issued safety recommendations to the manufacturers of personal watercraft (Kawasaki, Yamaha, Polaris, Bombardier, and Arctic Cat, Inc./Tiger Shark), the U.S. Coast Guard, the National Association of State Boating Law Administrators, the U.S. Coast Guard Auxiliary, BOAT/U.S., the Personal Watercraft Industry Association, and the Governors of the States and Territories.

The National Transportation Safety Board is an independent Federal agency with the statutory responsibility "to promote transportation safety by conducting independent accident investigations and by formulating safety improvement recommendations" (Public Law 93-633). The Safety Board is vitally interested in any actions taken as a result of its safety recommendations and would appreciate a response from you regarding action taken or contemplated with respect to the recommendation in this letter. Please refer to Safety Recommendation M-98-93 in your reply.

Chairman HALL, Vice Chairman FRANCIS, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in this recommendation.



By: Jim Hall
Chairman



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: June 25, 1998

In reply refer to: M-98-94

Mr. Richard Schwartz
President
BOAT/U.S.
880 South Pickett Street
Alexandria, Virginia 22304

Personal watercraft (PWC) are a type of recreational boat that has become increasingly popular in recent years. Manufacturers estimate that about 200,000 PWC are sold each year, and more than 1 million are in current operation. PWC now account for more than one-third of the new recreational boat sales in the United States.

Although the overall number of recreational boating fatalities has been declining in recent years, the number of personal watercraft-related fatalities has been increasing. At the time of the National Transportation Safety Board's 1993 recreational boating safety study, there were only 26 personal watercraft fatalities a year, and the Safety Board did not believe that separate consideration of PWC was warranted. However, in 1994, the number of PWC fatalities began to increase noticeably because the number of PWC in operation increased. Preliminary numbers for 1997 indicate 83 PWC fatalities. PWC are the only type of recreational vessel for which the leading cause of fatalities is not drowning; in PWC fatalities, more persons die from blunt force trauma than from drowning. The increase in fatalities and the distinctive way in which fatalities occur prompted the Safety Board to examine the nature of PWC accidents.

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control during off-throttle steering and cut-off ("kill") switches activated by the use of safety lanyards to stop the vessel if the operator is ejected, that underscore the need for training.

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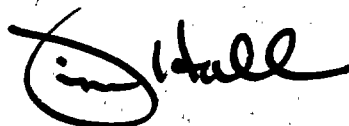
Therefore, the National Transportation Safety Board recommends that BOAT/U.S.:

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Chairman HALL, Vice Chairman FRANCIS, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in this recommendation.

A handwritten signature in black ink, appearing to read "Jim Hall", with a stylized flourish at the end.

By: Jim Hall
Chairman



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: June 25, 1998

In reply refer to: M-98-95 through -97

Mr. Ted Woolley
President
National Association of State
Boating Law Administrators
Division of Parks and Recreation
1594 W. North Temple, Suite 116
Salt Lake City, Utah 84114-6001

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The Safety Board also reviewed State reports of PWC accidents that occurred in 1996. A total of 49 States and Territories provided either copies of their boating accident report forms, automated boating accident report database files, or summary information for 1996 and/or 1997.

Because the States voluntarily provided the Safety Board with accident reports and supplemental questionnaire information, and because of the incomplete nature of much of the information, the Safety Board does not claim that the results of the study are representative of all PWC accidents. The Safety Board analyzed 814 (one-third) of the 1997 reported accidents, and examined all of the data for the 1996 reported accidents. Consequently, the Board believes that a substantial number of accidents was available to identify the most important safety issues associated with PWC accidents. Further, the Safety Board's analysis did not show any biases in the types of accidents in the half-year of 1997 accidents compared to the full year of 1996 accidents. The Safety Board's interest in truncating the data collection period to 6 months was based on a goal of providing the results of this study prior to the 1998 summer boating season.

Based on the analysis of the data reviewed, the safety issues discussed in the Safety Board's report include the following: protecting personal watercraft riders from injury, operator experience and training, and boating safety standards. The study also addresses the need for recreational boating exposure data. The discussion in this letter is limited to operator experience and training, which includes the topic of State PWC operating restrictions.

Operator Experience and Training

Each year, many first-time PWC operators are exposed to the boating environment. In the Safety Board's 1997 sample of PWC accidents, nearly half (48 percent) of the operators of rented PWC had operated a PWC only once or never; 18 percent of the operators of privately owned

² California, Delaware, Nevada, Washington, and the Territory of Puerto Rico.

PWC had previously operated a PWC only once or never. This lack of experience is particularly important for PWC because the vessels have special operating characteristics, such as the loss of control during off-throttle steering and cut-off ("kill") switches activated by the use of safety lanyards to stop the vessel if the operator is ejected, that underscore the need for training.

Operating a PWC requires a high degree of vigilance. Several PWC models can exceed 60 mph, but even at a speed of 40 mph, a PWC travels about 20 yards per second. As speeds increase, the time available to react decreases. PWC are highly maneuverable vessels that can change course quickly while under power, which presents a particular problem when several PWC are traveling together.³ The timeframe for perceptually tracking another PWC can also be quite limited under these conditions. Operators of two PWC traveling at 40 mph on a head-on course will have a response time of 1.3 seconds to travel 50 yards. Even when the vessels are converging on a 45-degree angle, the response time is less than 2 seconds.⁴ The response time must accommodate perceiving the other vessel, deciding which vessel is burdened to comply with rules of the road, determining the risk of collision, and executing a response to alter course. Under these conditions, inexperienced operators who are not aware of navigation rules⁵ that dictate which vessels have the right of way and, therefore, what direction of turn can be expected for vessels on conflicting routes, are faced with split-second decisions.

The Safety Board's analysis of the 1997 State boating accident reports showed that 87 percent of the PWC operators had received no boating instruction.⁶ The NTSB supplemental questionnaire submitted by the States indicated a similar proportion: 84 percent had completed no type of boating instruction.⁷ The need for boating instruction was addressed in the Safety Board's 1993 safety study of recreational boating; 81 percent of the operators involved in fatal accidents in that study had received no boating safety instruction.⁸ A review of 1996 Coast Guard boating statistics also illustrates that recreational boaters have a low exposure to safety education. Of the 709 recreational boating fatalities, educational experience was known for 340: 50 (15 percent) had received operator education, and 290 (85 percent) were known not to have received operator

³ State boating law administrators agree that PWC operations often involve riding close to other PWC.

⁴ 40 mph = 19.5 yd/sec. On a direct course, each vessel traverses 25 yards; on a converging course, each vessel travels 35.35 yards before intersecting.

⁵ PWC are subject to inland navigation rules as stated in USCG COMDTINST M16672.2B, dated August 17, 1990.

⁶ Training information was reported for 471 of the 1,218 PWC operators: 413 had none, and 58 had completed State courses, Coast Guard Auxiliary training, Power Squadron training, Red Cross training, or other (military) training. The duration of the reported training or quality of the course content may have varied.

⁷ Responses to a boater education question that was included on the supplemental questionnaire were reported for 712 of the 1,218 operators; of those responding, 600 (84 percent) had no training.

⁸ National Transportation Safety Board. 1993. Recreational boating safety. Safety Study NTSB/SS-93/01. Washington, DC. 104 p. The Safety Board's experience indicates that boating accidents involving a fatality are more likely to be reported than those involving less serious injury. Fatal accidents are also better documented. The Board used fatal accidents to illustrate the proportion of operators who had received boating education because it had greater confidence in the boating education data from that subset than from all accidents.

education. Data for 1991 through 1996 reflect similar proportions regarding the fatally injured operators who had received boating safety education.

Although no State or Territory requires a special boating license to operate a PWC, 16 jurisdictions have special boating education requirements to operate a PWC.⁹ Effective June 23, 1993, PWC operators in Connecticut were required to take a safe handling course to obtain a certificate for PWC operation; there are no exceptions. Mandatory education requirements include 10 hours of basic boating safety and an additional 2.5 hours of instruction concentrating on PWC safety. Even though there has been a substantial increase in the number of PWC operations, there have been no fatalities attributable to PWC operations in Connecticut in the past 10 years. The boating law administrator for Connecticut indicates that accidents and injuries have decreased over the last 5 years. Training is typically offered by the States' marine safety officers. Michigan's marine education program¹⁰ certified 50,554 students in classroom courses in 1996.¹¹ That State also conducts a PWC education/enforcement program that began in 1995; it involves 30 marine officers assigned to PWC patrol who review regulations, discuss safety, and give equipment demonstrations. Even with a growth in PWC operations, that State has seen a decrease in both PWC accidents and fatalities; PWC accidents in Michigan accounted for 45 percent of all boating accidents in 1995 and dropped to 41 percent in 1996.

On October 23, 1997, the Coast Guard issued a notice in the Federal Register requesting comments on a proposed Federal requirement for education in recreational boating. On March 20, 1998, the Coast Guard extended the comment period until May 29, 1998.¹² The Safety Board submitted comments supporting the need for operator education and training for recreational boaters and PWC operators, and reiterating the conclusions and recommendations of its 1993 study on recreational boating safety. The Board's comments noted that the lack of education reported for the PWC operators in the current study provides further support for the need for education of recreational boat and PWC operators.

The National Association of State Boating Law Administrators (NASBLA), BOAT/U.S., the Coast Guard Auxiliary, the U.S. Power Squadrons, the National Safe Boating Council, and the National Water Safety Congress support recreational boating education. NASBLA's Education Committee has a review process designed to standardize training information by approving boating safety curriculums. NASBLA has also developed a model PWC boating course. This course outline may be used by the individual States to pattern the courses they develop, and it serves as a guide to educational organizations that work within the local

⁹ The following States and Territories require PWC education: Colorado, Connecticut, Delaware, Georgia, Idaho, Kansas, Massachusetts, Minnesota, Nevada, Rhode Island, Tennessee, Texas, Utah, Wisconsin, U.S. Virgin Islands, and American Samoa. Nevada requires PWC education only of PWC operators who rent the vessel. (National Association of State Boating Law Administrators. 1997. Reference guide to State boating laws. 3d ed. Lexington, KY (p. 21). 182 p., plus appendixes.)

¹⁰ Michigan's course is only 1 hour long; most States require 6 to 8 hours of classroom instruction.

¹¹ *Small Craft Advisory*. Dec. 1997/Jan. 1998. Lexington, KY: National Association of State Boating Law Administrators; 13(2): 20.

¹² Federal Register, Vol. 63, No. 54, dated March 20, 1998, page 13585.

communities to provide training. In addition to NASBLA's education efforts, the Personal Watercraft Industry Association (PWIA) has also been developing model PWC education requirements. PWIA advocates mandatory education for PWC operators and has mandatory education as an element of its model legislation.

PWC manufacturers provide safety information in printed and video formats with every PWC sold, and dealers are asked to review these safety techniques with customers. The PWIA has also developed classroom material used in several State safety education courses. One manufacturer recently introduced a PWC training program that requires dealers to deliver a boating safety presentation (video and law review) to all purchasers of new PWC.¹³ The product cannot be warranty-registered until the customer receives the information. The Safety Board commends industry efforts to provide PWC owners with point-of-purchase education and training. However, this point-of-purchase information may not reach relatives and friends of the PWC owner who may use the vessel. In its 1993 study on recreational boating, the Safety Board recommended that each State

Implement minimum recreational boating safety standards to reduce the number and severity of accidents; consider requirements such as mandatory use of personal flotation devices for children, demonstration of operator knowledge of safe boating rules and skills, and operator licensing. (M-93-1).¹⁴

Although some progress has been made in responding to the Safety Board's recommendation, as shown by the 4 States that now require boater certification and the 20 that mandate boating education, the Safety Board continues to believe that if more recreational boaters were trained, the number of persons killed and injured in recreational boating accidents, including those involving PWC, would be reduced. Therefore, the Safety Board is reiterating Safety Recommendation M-93-1 in the report of its PWC study. Because two-thirds of PWC owners also owned a powerboat prior to purchasing a PWC,¹⁵ it is reasonable to believe that powerboat operators taking a recreational boating education course may someday be PWC owners or operators. To reach the maximum number of persons who may operate a privately owned PWC, recreational boating education courses should provide some level of PWC training. This is not to say that all boaters should take a PWC course, but rather that all recreational boating courses should address PWC safety issues. Therefore, the Safety Board believes that the States, the Coast Guard Auxiliary, BOAT/U.S., the U.S. Power Squadrons, and NASBLA should include information on the safe operation of PWC in all recreational boating courses.

The Safety Board is concerned about persons who rent PWC. Nearly one-quarter of the PWC operators involved in the accidents analyzed by the Safety Board for this study (292 of

¹³ Polaris Industries, Inc.

¹⁴ Safety Recommendation M-93-1 has been classified "Closed—Acceptable Action" for 7 States, "Open—Acceptable Response" for 28 States, "Open—Response Received" for 4 States, "Open—Awaiting Response" for 9 States, and "Closed—Unacceptable Action" for 4 States.

¹⁵ Bowe Marketing Research. 1996. PWIA owner usage, attitude, and demographic research. Survey of PWC owners commissioned by the PWIA and presented at the PWIA Board of Directors meeting July 23, 1996.

1,218, or 24 percent) were operating rented PWC.¹⁶ Accident case analysis showed that 68 percent of the operators of rented PWC were under age 25, and 73 percent had been riding less than 1 hour at the time of the accident; 84 percent of the accidents involved collision with another vessel.

There was limited reporting of PWC renters who received safety information (110 of 292 rentals), but for those for whom the information was reported, the safety information was usually transmitted by verbal instruction (56 percent). Only one out of three PWC renters included in the Safety Board's accident analysis indicated that the rental agent had required them to demonstrate PWC riding ability. To encourage all rental businesses to be responsible partners in safe boating, the PWIA provides a free education package for PWC rental businesses. The package includes a videotape, waterproof checklist, safety posters, and safety literature.

Nearly half of the rented PWC in the Safety Board's accident sample were operated by out-of-state residents. If the PWC was rented, 48 percent of the operators reported were not State residents (132 of 277); for nonrented PWC, only 11 percent of the accident operators resided outside the State (80 of 757). Out-of-state operators may be less familiar with the recreational waterways in which they are operating the PWC and with the local boating regulations.

Operators of rented PWC were twice as likely as operators of personally owned PWC to have ridden the vessel less than 1 hour before the accident occurred. The Board's review of the data indicate that 73 percent of rental-operator accidents occurred within the first hour of operation (102 of 139) compared with 39 percent for nonrental operators (107 of 272). However, this finding may be confounded by the fact that PWC are rented by the hour and some portion of renters will rent the vessels for only an hour. About half of the operators of rented PWC had previously operated a PWC only once or never; this underscores the need for PWC education and training.

Reported causes of the accidents involving rented PWC appeared to show a somewhat different pattern than nonrented PWC. Operators of rented PWC were somewhat more likely to have accidents reported as resulting from inexperience and inattention, but they were not as likely to have an accident reported as resulting from inappropriate speed for the operating conditions.

Twenty States have taken steps to address the safety of PWC rental operations. For example, in Oregon and Florida, the minimum age (by statute) to operate a PWC is 14, but it is 16 for operators who rent PWC. In Wisconsin, the allowable operating age with training and adult supervision is 12, but 16 for those who rent a vessel. Idaho law effective July 1996 specifically requires all rental businesses and agents to educate all PWC renters concerning the safe operation of the vessel and to place a decal on the vessel that lists safe operating techniques and boating laws. The law requires the renter to take the education (PWC video and instruction provided at

¹⁶ Boating accident report forms of all States contain a field to designate whether or not the vessel was rented. Rental information was provided for 85 percent (1,034 of the 1,218) of the PWC operators involved in the accidents that occurred during the January-June 1997 study period.

the point of rental) and to carry an acknowledgment-of-education form while operating the PWC. Violation is an infraction of the law. Florida requires an on-water checkride to be provided by rental agents. Nevada requires not only the renter, but each person who will operate under the rental contract, to receive instruction in the laws and safe operation of the PWC. A dozen States specify education or training requirements that rental agents must provide PWC renters.

Accident data showed that operators of rented PWC in the study sample had less PWC experience than did operators of privately owned personal watercraft. Considering the unique operating characteristics of PWC, this lack of experience creates a safety risk. Given that the percentage of PWC accidents that occur within the first hour was almost twice as high for rented PWC as for nonrented PWC (73 percent compared to 39 percent), that half of the accident-involved rental operators had limited or no experience on a PWC, and that about two-thirds of accident-involved PWC renters had not had to demonstrate their ability to operate the vessel, the Safety Board believes that States should enact or revise their recreational boating laws, as necessary, to require rental businesses to provide safety instruction training to all persons who operate rented PWC and to require the operators to demonstrate their PWC riding ability. The Safety Board also believes that NASBLA, in conjunction with the Coast Guard and the PWIA, should develop a checklist for boat rental businesses to use for evaluating a person's ability to operate a personal watercraft.

The States' 1997 PWC accident cases analyzed by the Safety Board involved 77 PWC operators age 15 or under (6.3 percent of the accident-involved PWC operators). Fifty-one States and Territories have established a minimum age, by statute, for PWC operation. However, there is a wide disparity among State laws regarding the age at which a young person can operate a PWC. In most States, provisions exist that allow operators who are younger than the minimum age by statute to operate a PWC. For example, boater training or PWC certification (for PWC operating privileges at a special age) is required in 23 States and 2 Territories. Colorado law, for example, has a minimum PWC operating age of 16, but the age is lowered to 14 for holders of a PWC training certificate. Thirty States and 2 Territories have provisions for adult supervision of younger PWC operators.

Recent legislative activity by some States tends to show movement toward raising the minimum age for operating PWC. For example, California set new minimum age standards that took effect in January 1998: PWC operators must be at least 16 years old. But the new law allows persons 12 to 15 years of age to operate a PWC with adult supervision. Maryland recently set the minimum PWC operator age at 16.¹⁷ In a boating survey conducted by Virginia,¹⁸ where PWC operators can be as young as age 14,¹⁹ 81 percent of the survey respondents believed there

¹⁷ Maryland regulations are published in Title 8 Department of Natural Resources, Subtitle 18: Boating—Speed Limits and Operation of Vessels, Chapter 2: Personal Watercraft, Paragraph 5: Restrictions.

¹⁸ Virginia Department of Game and Inland Fisheries. 1997. Boating education in Virginia. Richmond.

¹⁹ The Commonwealth of Virginia's General Assembly and Senate passed new PWC age requirements effective January 1, 1999: persons ages 14 and 15 may operate a PWC with training and age 16 without training. A training card must be carried by 14- and 15-year-old operators.

should be a minimum age to operate a motorboat: 33 percent believed the age should be 14, and 40 percent believed the age should be 16.

The PWIA and NASBLA have developed model acts for PWC that States may use in their legislative initiatives. The PWIA model act proposes 16 as the minimum operator age: it has advocated 16 as the minimum operator age since 1988. Twenty-one of the 56 States and Territories with statutes that specify a minimum age requirement have set 16 as the minimum age for PWC operators; 7 States and Territories have an older age requirement. The NASBLA model act also proposes age 16; however, that act includes a provision for 12- to 16-year-olds to operate a PWC if a person age 18 or older is on board the vessel.

All but five jurisdictions have established a minimum operating age, but many States have special provisions for training, certification, or adult supervision that substantially lower the minimum age requirement. Of the 28 States and Territories with statutes that have set a minimum age of 16 years or older, all but 6 have special provisions that allow PWC operation at a younger age than set by statute. The Safety Board supports the initiatives by NASBLA, the PWIA, and the States to establish State statutes that set 16 as the minimum operating age, and the Board acknowledges efforts to promote safety through boater education, certification, and supervision. The Safety Board is concerned, however, that special provisions are being used to lower or negate minimum operator age requirements and believes that NASBLA should examine the effects of special provisions on the operator minimum age requirement for PWC.

Therefore, the National Transportation Safety Board recommends that the National Association of State Boating Law Administrators:

- Include information on the safe operation of personal watercraft in all recreational boating courses. (M-98-95)

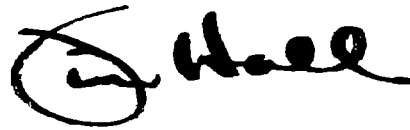
- Develop, in conjunction with the U.S. Coast Guard and the Personal Watercraft Industry Association, a checklist for boat rental businesses to use for evaluating a person's ability to operate a personal watercraft. (M-98-96)

- Examine the effects of special provisions on the operator minimum age requirement for personal watercraft. (M-98-97)

Also as a result of this study, the Safety Board issued safety recommendations to the manufacturers of personal watercraft (Kawasaki, Yamaha, Polaris, Bombardier, and Arctic Cat, Inc./Tiger Shark), the U.S. Coast Guard, the U.S. Coast Guard Auxiliary, the Personal Watercraft Industry Association, the U.S. Power Squadrons, BOAT/U.S., and the Governors of the States and Territories.

The National Transportation Safety Board is an independent Federal agency with the statutory responsibility "...to promote transportation safety by conducting independent accident investigations and by formulating safety improvement recommendations" (Public Law 93-633). The Safety Board is vitally interested in any actions taken as a result of its safety recommendations and would appreciate a response from you regarding action taken or contemplated with respect to the recommendations in this letter. Please refer to Safety Recommendations M-98-95 through -97 in your reply.

Chairman HALL, Vice Chairman FRANCIS, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in these recommendations.

A handwritten signature in black ink, appearing to read "J. Hall", with a large, stylized initial "J" and a long, sweeping underline.

By: Jim Hall
Chairman



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: June 25, 1998

In reply refer to: M-98-98 and -99

Mr. John Donaldson
Executive Director
Personal Watercraft Industry Association
1819 L Street, N.W., Suite 700
Washington, D.C. 20036

Personal watercraft (PWC) are a type of recreational boat that has become increasingly popular in recent years. Manufacturers estimate that about 200,000 PWC are sold each year, and more than 1 million are in current operation. PWC now account for more than one-third of the new recreational boat sales in the United States.

Although the overall number of recreational boating fatalities has been declining in recent years, the number of personal watercraft-related fatalities has been increasing. At the time of the National Transportation Safety Board's 1993 recreational boating safety study, there were only 26 personal watercraft fatalities a year, and the Safety Board did not believe that separate consideration of PWC was warranted. However, in 1994, the number of PWC fatalities began to increase noticeably because the number of PWC in operation increased. Preliminary numbers for 1997 indicate 83 PWC fatalities. PWC are the only type of recreational vessel for which the leading cause of fatalities is not drowning; in PWC fatalities, more persons die from blunt force trauma than from drowning. The increase in fatalities and the distinctive way in which fatalities occur prompted the Safety Board to examine the nature of PWC accidents.

The Safety Board initiated a study to more closely examine fatalities and injury in addition to accident characteristics associated with PWC accidents.¹ The study was not designed to estimate how often PWC accidents occur. The Safety Board examined 1,739 PWC accident reports for accidents that occurred during an 18-month period, January 1996 through June 1997. For PWC accidents that occurred between January and June 1997, the Safety Board requested that State marine accident investigators provide the Safety Board with copies of their accident reports and complete a supplemental questionnaire prepared by the Safety Board specifically for

¹ National Transportation Safety Board. 1998. Personal Watercraft Safety. Safety Study NTSB/SS-98/01. Washington, DC.

this study. The goal of the supplemental questionnaire was to obtain additional information concerning the accident characteristics and details concerning personal injury that have not previously been available from State boating accident reports. State accident reports and supplemental information were the sources of the Safety Board's accident information.

For the January-June 1997 period, the Safety Board received boating accident reports and questionnaire responses from 37 participating States and Territories. Boating accident reports were not always accompanied by supplemental questionnaires. Also, because of concerns over personal privacy issues, five States² did not provide the Safety Board with copies of their boating accident reports but did provide supplemental questionnaires. Consequently, the boating accident reports and the supplemental questionnaires represent two different but substantially overlapping sets of data, which contain information on a total of 814 PWC accidents involving 1,218 operators.

The Safety Board also reviewed State reports of PWC accidents that occurred in 1996. A total of 49 States and Territories provided either copies of their boating accident report forms, automated boating accident report database files, or summary information for 1996 and/or 1997.

Because the States voluntarily provided the Safety Board with accident reports and supplemental questionnaire information, and because of the incomplete nature of much of the information, the Safety Board does not claim that the results of the study are representative of all PWC accidents. The Safety Board analyzed 814 (one-third) of the 1997 reported accidents, and examined all of the data for the 1996 reported accidents. Consequently, the Board believes that a substantial number of accidents was available to identify the most important safety issues associated with PWC accidents. Further, the Safety Board's analysis did not show any biases in the types of accidents in the half-year of 1997 accidents compared to the full year of 1996 accidents. The Safety Board's interest in truncating the data collection period to 6 months was based on a goal of providing the results of this study prior to the 1998 summer boating season.

Based on the analysis of the data reviewed, the safety issues discussed in the Safety Board's report include the following: protecting personal watercraft riders from injury, operator experience and training, and boating safety standards. The study also addressed the need for recreational boating exposure data. The discussion in this letter is limited to operator experience and training, and boating safety standards.

Operator Experience and Training

For the January-June 1997 period, experience was reported for half (613) of the 1,218 PWC operators involved in the accidents.³ Nearly a third of all operators (32 percent) reported that they had operated a PWC between zero and 10 times prior to the accident: 86 never, 75

² California, Delaware, Nevada, Washington, and the Territory of Puerto Rico.

³ The Safety Board recognizes that the data on this topic are based on self-report and may be an overestimate of the number of PWC operators with experience and training.

once, and 225 between 2 and 10 times. PWC operators with experience of more than 10 times accounted for 18 percent (220 of the 1,218 operators).

Operator education or training was reported by 712 PWC operators: 84 percent of those operators reported that they had no training, whereas 16 percent had received some form of boating instruction. The results concerning PWC operator training are consistent with the Safety Board's findings in its 1993 study of recreational boating: as few as 7 percent and no more than 22 percent of the persons operating a boat for the first time had taken a boating safety course.⁴

On October 23, 1997, the Coast Guard issued a notice in the Federal Register requesting comments on a proposed Federal requirement for education in recreational boating. On March 20, 1998, the Coast Guard extended the comment period until May 29, 1998.⁵ The Safety Board submitted comments supporting the need for operator education and training for recreational boaters and PWC operators, and reiterating the conclusions and recommendations of its 1993 study on recreational boating safety. The Board's comments noted that the lack of education reported for the PWC operators in the current study provides further support for the need for education of recreational boat and PWC operators.

Accident data showed that operators of rented PWC in the study sample had less PWC experience than did operators of privately owned personal watercraft. Considering the unique operating characteristics of PWC, this lack of experience creates a safety risk. Given that the percentage of PWC accidents that occur within the first hour was almost twice as high for rented PWC as for nonrented PWC (73 percent compared to 39 percent), that half of the accident-involved rental operators had limited or no experience on a PWC, and that about two-thirds of accident-involved PWC renters had not had to demonstrate their ability to operate the vessel, the Safety Board is recommending that States should enact or revise their recreational boating laws, as necessary, to require rental businesses to provide safety instruction training to all persons who operate rented PWC; all the operators should be required to demonstrate their ability to operate and control a PWC. The Safety Board also believes that the Personal Watercraft Industry Association (PWIA), in conjunction with the National Association of State Boating Law Administrators (NASBLA) and the Coast Guard, should develop a checklist for boat rental businesses to use for evaluating a person's ability to operate a personal watercraft.

Boating Safety Standards

Manufacturers of inboard and outboard motorboats must meet safety standards for the manufacture of boats and associated equipment (33 CFR Part 183), including requirements for certification and labeling (Part 181) and defect notification (Part 179). The standards and regulations of Part 183 specifically address capacity, loading, flotation, electrical systems, fuel

⁴ National Transportation Safety Board. 1993. Recreational boating safety. Safety Study NTSB/SS-93/01. Washington, DC (p. 50). 104 p.

⁵ Federal Register, Vol. 63, No. 54, dated March 20, 1998, page 13585.

systems, and ventilation. In addition to the provisions included in the regulations, many requirements are incorporated by reference.⁶

Federal statutes authorize the Coast Guard to issue exemptions from safety standards for manufacturers of boats to which the application of a standard is impractical or unreasonable and when the manufacturer can show that granting the exemption will not adversely affect boating safety.⁷ Manufacturers must petition the Coast Guard for exemption from safety standards. The Coast Guard has granted exemptions to every petition received from PWC manufacturers, and for each model for which an exemption was requested.⁸

Personal watercraft, as a vessel design category, cannot comply with the Coast Guard standards as currently written, and thus the exemptions from the existing standards are unavoidable. The following examples are provided to explain why PWC need exemptions from the existing standards:

- The safe loading standard, as currently written, is based on the assumption that water will flow into the vessel. If there is no load area into which water will flow, it is impossible to test a vessel in accordance with the safe loading standard; safe loading standards determine the weight limits appropriate for a particular vessel, and, by correlation, determine the person capacity.⁹
- In addition, if weight capacities cannot be determined in accordance with the safe loading standard, it becomes difficult to determine the required volume of flotation material for compliance with the flotation standard,¹⁰ thus PWC are also exempted from the flotation standard and from requirements for labeling the capacity of the PWC.¹¹

⁶ Information incorporated by reference (as listed in Paragraph 183.5) includes recommended practices developed by the Institute of Electrical and Electronics Engineers, Inc., electrical code requirements of the National Fire Protection Association, recommended practices of the Society of Automotive Engineers, Inc., and the Underwriters Laboratory, Inc.

⁷ The Coast Guard's authorization was described in correspondence dated January 17, 1995, between U.S. Coast Guard Chief, Recreational Boating Product Assurance Branch, and the Chairman of the National Association of State Boating Law Administrators.

⁸ The Coast Guard has issued exemptions from its standards for both inboard- and outboard-powered personal watercraft, hovercraft, airboats, raceboats, and submarines.

⁹ To receive an exemption, PWC manufacturers provide the Coast Guard with test data to show adequate flotation, boat weight and passenger capacity, and the amount of flotation material installed. Based on this information, the Coast Guard determines whether each PWC model contains sufficient flotation to meet the intent of the standard.

¹⁰ Basic flotation, as applied to inboard and inboard-outdrive boats, requires sufficient flotation material so that if the vessel capsizes or swamps, the boat will remain floating with some portion of its hull above the surface of the water.

¹¹ Manufacturers are considering the use of a capacity label that would indicate the rated person capacity. The proposed capacity marking label would state that the vessel complies with ISO 13590 of the International Standards Organization and that it is certified by the National Marine Manufacturers Association.

- Manufacturers of personal watercraft have also received exemptions from electrical and fuel systems standards and from the requirement for powered ventilation in the ventilation standard. The manufacturers' main justification for requesting these exemptions is that PWC design features minimize the possibility of arcing or sparks; specifically, fuel systems minimize the possibility of fuel vapor leakage, and the comparatively smaller size of the engine compartment compared to larger, more conventional boats limit the air supply and the PWC's ability to support combustion. Because PWC have a tendency to capsize and could take on water through their blowers, the powered ventilation standards, as currently written, cannot be applied.

Voluntary industry construction standards have been developed by the Society of Automotive Engineers (SAE) and the International Standards Organization (ISO); these standards are similar to the Coast Guard boat standards but are specific to PWC. SAE's Personal Watercraft Subcommittee of the Marine Technical Committee has developed standards to address personal watercraft flotation (Recommendation Practice J1973), electrical systems (J2120), fuel systems (J2046), and ventilation (J2034). In its rationale for issuing these standards, the SAE recognized that PWC cannot comply with the Coast Guard regulations for conventional boat system designs, and it recognized the specific differences that affect PWC system requirements. For example, the SAE fuel system standard is more stringent than Coast Guard requirements; the SAE standard requires that the PWC system not leak liquid fuel into the vessel when rotated through a 180-degree roll in either direction or overturned through 90 degrees of pitch in either direction. The Safety Board recognizes that industry representatives serve on SAE committees and that all of the major PWC manufacturers voluntarily comply with the SAE standards. Industry representatives have also contributed to the development of ISO standards, which are similar to SAE standards.

In May 1997, NASBLA asked the Coast Guard to consider developing standards for PWC. Based on this request, the Coast Guard noted the similarities between SAE and ISO standards and specifically identified the differences between SAE standards and the existing safety standards as defined in Part 183. In October 1997, the Coast Guard's Boating Safety Advisory Committee requested the Coast Guard to review how manufacturers determine capacity on multiple-occupant rated PWC models—how the lack of an industry-wide standard for determining and displaying "persons capacity" impacts rider safety, including consideration of accident data. Coast Guard staff, in a meeting with Safety Board staff on April 10, 1998, indicated that there was no compelling statistical evidence that PWC problems warrant modifying existing safety standards for flotation (capacity), electrical system, fuel systems, and ventilation.

The Safety Board notes that the Coast Guard's four standards were developed, in part, to address the most serious safety concerns of traditional motorboats: drowning, fire, and explosion. The Safety Board's study clearly points out, however, that these are not the most prevalent safety concerns for PWC. PWC, as previously mentioned, is the only type of recreational vessel for which the leading cause of death is not drowning. Also, in traditional boats, falling overboard and swamping would be considered emergency situations; however, for PWC, these are expected

events and, consequently, PWC are designed and constructed to different design criteria than traditional boats.

The Safety Board questions the need for the Coast Guard to continue the exemption process for PWC, particularly given that industry standards exist (and in certain areas are more stringent than the Coast Guard's), that there is voluntary compliance with the standards, and that the standards appear to provide an equivalent level of safety as envisioned by the Coast Guard standards. The Safety Board concludes that the existing process of exempting PWC from standards that were defined for conventional boats is an inappropriate method for certifying the safety and seaworthiness of PWC. In the Safety Board's opinion, the exemption process does little in terms of evaluating possible safety risks that may be associated with the unique operating characteristics of PWC. The Safety Board is aware that the Coast Guard is working with the PWIA to incorporate SAE standards by reference as an alternate method of compliance with existing Federal regulations. The fact that PWC do not "fit" existing standards for open-hull vessels does not release the Coast Guard from its responsibility to regulate the safety of these vessels, particularly since personal watercraft now represent more than one-third of the new recreational boats sold. The Safety Board is recommending, therefore, that the Coast Guard eliminate the existing process of exempting PWC from standards that were defined for conventional boats and develop, in conjunction with the manufacturers of personal watercraft, comprehensive standards that are specific to the safety risks of PWC.

The Safety Board notes, however, that industry has voluntarily complied only with those standards that address the existing Coast Guard boating safety standards (flotation, capacity, electrical, fuel, and ventilation) that were established for conventional boats. The Safety Board is concerned that there are other safety issues associated with PWC that warrant attention. The need for improved steering control and prevention of "runaway" PWC once an operator is ejected serve as two prime examples of areas where improvements in design could result in a decrease in accidents.

State marine accident investigators have recognized that steering issues are associated with many PWC accidents. The Safety Board reviewed available accident reports for 1996 and 1997 and, based on narrative information contained in the accident reports, determined that more than 350 (20 percent) of the cases reviewed indicated steering or loss of control problems. Accident reports reviewed for the Safety Board's study highlight problems of operator control during off-throttle steering situations. Some portion of operator control problems may be attributed to the operating design of personal watercraft.

The narrative report of an accident that occurred in Illinois included the following investigator comment: "She (V1) stated that as they came close, she let off the throttle and then tried to turn but couldn't. She stated that V2 hit her in the side of the Sea-Doo causing a tremendous amount of damage.... V2 advised that as she came close to V1 she turned to avoid her, but it didn't turn because she let off of the throttle." The report of a fatal Missouri accident included the following investigator comments: "He did not think that she knew that he was behind her. He said that it was less than a second between when she turned and when he struck her. He let go of the throttle, but it did not help."

On September 10, 1997, NASBLA adopted a resolution (No. 97-3) petitioning the Coast Guard to evaluate off-throttle steering of jet-pump propelled craft and to develop appropriate standards. The Coast Guard issued a grant request in October 1997.¹² The objective of this work will be to identify the most effective of the available and emerging technologies/methodologies in the area of off-throttle steering. As part of the background information in the grant description, the Coast Guard stated: "A large percentage of accidents involving jet-pump propelled craft involve collisions with other craft or fixed objects. Because of the unique relationship between the amount of throttle and steering response on jet-pump propelled craft, there is concern that a sudden loss of engine power—either due to part failure or operator decision—may play a significant role in these collisions." Announcement of the grant award is anticipated in the near future. The Safety Board study data support the need for this research, and an evaluation of PWC steering design is warranted. The Safety Board is concerned that the Coast Guard has not taken a proactive role in assessing the safety risks of PWC. Therefore, the Safety Board is recommending that within 2 years the Coast Guard determine, through research, the feasibility of providing PWC operators more control in an off-throttle steering situation (Safety Recommendation M-98-88). The Safety Board also believes that the PWIA should work with the Coast Guard to use the results of this research to develop appropriate standards for steering on jet-pump propelled vessels.

Therefore, the National Transportation Safety Board recommends that the Personal Watercraft Industry Association:

Develop, in conjunction with the U.S. Coast Guard and the National Association of State Boating Law Administrators, a checklist for boat rental businesses to use for evaluating a person's ability to operate a personal watercraft. (M-98-98)

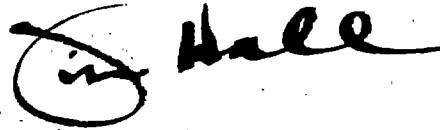
Work with the U.S. Coast Guard to use the results of off-throttle steering research described in Safety Recommendation M-98-88 to the Coast Guard to develop appropriate standards for steering on jet-pump propelled vessels. (M-98-99)

Also as a result of this study, the Safety Board issued safety recommendations to the manufacturers of personal watercraft (Kawasaki, Yamaha, Polaris, Bombardier, and Arctic Cat, Inc./Tiger Shark), the U.S. Coast Guard, the U.S. Coast Guard Auxiliary, the National Association of State Boating Law Administrators, the U.S. Power Squadrons, BOAT/U.S., and the Governors of the States and Territories.

The National Transportation Safety Board is an independent Federal agency with the statutory responsibility "...to promote transportation safety by conducting independent accident investigations and by formulating safety improvement recommendations" (Public Law 93-633). The Safety Board is vitally interested in any actions taken as a result of its safety recommendations and would appreciate a response from you regarding action taken or contemplated with respect to the recommendations in this letter. Please refer to Safety Recommendations M-98-98 and -99 in your reply.

¹² Federal Register, Vol. 62, No. 193, dated October 6, 1997, page 52176.

Chairman HALL, Vice Chairman FRANCIS, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in these recommendations.

A handwritten signature in black ink, appearing to read "Jim Hall". The signature is written in a cursive style with a large, stylized "J" and "H".

By: Jim Hall
Chairman



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: June 25, 1998

In reply refer to: M-98-100 and -101, and
M-98-102 and M-93-1 to applicable States

To the Governors of the
States and Territories,
and the Mayor of the
District of Columbia
(see attached mailing list)

Personal watercraft (PWC) are a type of recreational boat that has become increasingly popular in recent years. Manufacturers estimate that about 200,000 PWC are sold each year, and more than 1 million are in current operation. PWC now account for more than one-third of the new recreational boat sales in the United States.

Although the overall number of recreational boating fatalities has been declining in recent years, the number of personal watercraft-related fatalities has been increasing. At the time of the National Transportation Safety Board's 1993 recreational boating safety study, there were only 26 personal watercraft fatalities a year, and the Safety Board did not believe that separate consideration of PWC was warranted. However, in 1994, the number of PWC fatalities began to increase noticeably because the number of PWC in operation increased. Preliminary numbers for 1997 indicate 83 PWC fatalities. PWC are the only type of recreational vessel for which the leading cause of fatalities is not drowning; in PWC fatalities, more persons die from blunt force trauma than from drowning. The increase in fatalities and the distinctive way in which fatalities occur prompted the Safety Board to examine the nature of PWC accidents.

The Safety Board initiated a study to more closely examine fatalities and injury in addition to accident characteristics associated with PWC accidents.¹ The study was not designed to estimate how often PWC accidents occur. The Safety Board examined 1,739 PWC accident reports for accidents that occurred during an 18-month period, January 1996 through June 1997. For PWC accidents that occurred between January and June 1997, the Safety Board requested that State marine accident investigators provide the Safety Board with copies of their accident reports and complete a supplemental questionnaire prepared by the Safety Board specifically for

¹ National Transportation Safety Board. 1998. Personal Watercraft Safety. Safety Study NTSB/SS-98/01. Washington, DC.

this study. The goal of the supplemental questionnaire was to obtain additional information concerning the accident characteristics and details concerning personal injury that have not previously been available from State boating accident reports. State accident reports and supplemental information were the sources of the Safety Board's accident information.

For the January-June 1997 period, the Safety Board received boating accident reports and questionnaire responses from 37 participating States and Territories. Boating accident reports were not always accompanied by supplemental questionnaires. Also, because of concerns over personal privacy issues, five States² did not provide the Safety Board with copies of their boating accident reports but did provide supplemental questionnaires. Consequently, the boating accident reports and the supplemental questionnaires represent two different but substantially overlapping sets of data, which contain information on a total of 814 PWC accidents involving 1,218 operators.

The Safety Board also reviewed State reports of PWC accidents that occurred in 1996. A total of 49 States and Territories provided either copies of their boating accident report forms, automated boating accident report database files, or summary information for 1996 and/or 1997.

Because the States voluntarily provided the Safety Board with accident reports and supplemental questionnaire information, and because of the incomplete nature of much of the information, the Safety Board does not claim that the results of the study are representative of all PWC accidents. The Safety Board analyzed 814 (one-third) of the 1997 reported accidents and examined all of the data for the 1996 reported accidents. Consequently, the Board believes that a substantial number of accidents was available to identify the most important safety issues associated with PWC accidents. Further, the Safety Board's analysis did not show any biases in the types of accidents in the half-year of 1997 accidents compared to the full year of 1996 accidents. The Safety Board's interest in truncating the data collection period to 6 months was based on a goal of providing the results of this study prior to the 1998 summer boating season.

Based on the analysis of the data reviewed, the safety issues discussed in the Safety Board's report include the following: protecting personal watercraft riders from injury, operator experience and training, and boating safety standards. The study also addresses the need for recreational boating exposure data and the use of personal flotation devices (PFDs). The discussion in this letter is limited to operator experience and training and the use of PFDs.

Operator Experience and Training

Each year, many first-time PWC operators are exposed to the boating environment. In the Safety Board's 1997 sample of PWC accidents, nearly half (48 percent) of the operators of rented PWC had operated a PWC only once or never; 18 percent of the operators of privately owned PWC had previously operated a PWC only once or never. This lack of experience is particularly important for PWC because the vessels have special operating characteristics, such as the loss of

² California, Delaware, Nevada, Washington, and the Territory of Puerto Rico.

control during off-throttle steering and cut-off ("kill") switches activated by the use of safety lanyards to stop the vessel if the operator is ejected, that underscore the need for training.

Operating a PWC requires a high degree of vigilance. Several PWC models can exceed 60 mph, but even at a speed of 40 mph, a PWC travels about 20 yards per second. As speeds increase, the time available to react decreases. PWC are highly maneuverable vessels that can change course quickly while under power, which presents a particular problem when several PWC are traveling together.³ The timeframe for perceptually tracking another PWC can also be quite limited under these conditions. Operators of two PWC traveling at 40 mph on a head-on course will have a response time of 1.3 seconds to travel 50 yards. Even when the vessels are converging on a 45-degree angle, the response time is less than 2 seconds.⁴ The response time must accommodate perceiving the other vessel, deciding which vessel is burdened to comply with rules of the road, determining the risk of collision, and executing a response to alter course. Under these conditions, inexperienced operators who are not aware of navigation rules⁵ that dictate which vessels have the right of way and, therefore, what direction of turn can be expected for vessels on conflicting routes, are faced with split-second decisions.

The Safety Board's analysis of the 1997 State boating accident reports showed that 87 percent of the PWC operators had received no boating instruction.⁶ The NTSB supplemental questionnaire submitted by the States indicated a similar proportion: 84 percent had completed no type of boating instruction.⁷ The need for boating instruction was addressed in the Safety Board's 1993 safety study of recreational boating; 81 percent of the operators involved in fatal accidents in that study had received no boating safety instruction.⁸ A review of 1996 Coast Guard boating statistics also illustrates that recreational boaters have a low exposure to safety education. Of the 709 recreational boating fatalities, educational experience was known for 340: 50 (15 percent) had received operator education, and 290 (85 percent) were known not to have received operator education. Data for 1991 through 1996 reflect similar proportions regarding the fatally injured operators who had received boating safety education.

³ State boating law administrators agree that PWC operations often involve riding close to other PWC.

⁴ 40 mph = 19.5 yd/sec. On a direct course, each vessel traverses 25 yards; on a converging course, each vessel travels 35.35 yards before intersecting.

⁵ PWC are subject to inland navigation rules as stated in USCG COMDTINST M16672.2B, dated August 17, 1990.

⁶ Training information was reported for 471 of the 1,218 PWC operators: 413 had none, and 58 had completed State courses, Coast Guard Auxiliary training, Power Squadron training, Red Cross training, or other (military) training. The duration of the reported training or quality of the course content may have varied.

⁷ Responses to a boater education question that was included on the supplemental questionnaire were reported for 712 of the 1,218 operators; of those responding, 600 (84 percent) had no training.

⁸ National Transportation Safety Board. 1993. Recreational boating safety. Safety Study NTSB/SS-93/01. Washington, DC. 104 p. The Safety Board's experience indicates that boating accidents involving a fatality are more likely to be reported than those involving less serious injury. Fatal accidents are also better documented. The Board used fatal accidents to illustrate the proportion of operators who had received boating education because it had greater confidence in the boating education data from that subset than from all accidents.

Although no State or Territory requires a special boating license to operate a PWC, 16 jurisdictions have special boating education requirements to operate a PWC.⁹ Effective June 23, 1993, PWC operators in Connecticut were required to take a safe handling course to obtain a certificate for PWC operation; there are no exceptions. Mandatory education requirements include 10 hours of basic boating safety and an additional 2.5 hours of instruction concentrating on PWC safety. Even though there has been a substantial increase in the number of PWC operations, there have been no fatalities attributable to PWC operations in Connecticut in the past 10 years. The boating law administrator for Connecticut indicates that accidents and injuries have decreased over the last 5 years. Training is typically offered by the States' marine safety officers. Michigan's marine education program¹⁰ certified 50,554 students in classroom courses in 1996.¹¹ That State also conducts a PWC education/enforcement program that began in 1995; it involves 30 marine officers assigned to PWC patrol who review regulations, discuss safety, and give equipment demonstrations. Even with a growth in PWC operations, that State has seen a decrease in both PWC accidents and fatalities; PWC accidents in Michigan accounted for 45 percent of all boating accidents in 1995 and dropped to 41 percent in 1996.

On October 23, 1997, the Coast Guard issued a notice in the Federal Register requesting comments on a proposed Federal requirement for education in recreational boating. On March 20, 1998, the Coast Guard extended the comment period until May 29, 1998.¹² The Safety Board submitted comments supporting the need for operator education and training for recreational boaters and PWC operators, and reiterating the conclusions and recommendations of its 1993 study on recreational boating safety. The Board's comments noted that the lack of education reported for the PWC operators in the current study provides further support for the need for education of recreational boat and PWC operators.

The National Association of State Boating Law Administrators (NASBLA), BOAT/U.S., the U.S. Power Squadrons, the National Safe Boating Council, and the National Water Safety Congress support recreational boating education. NASBLA's Education Committee has a review process designed to standardize training information by approving boating safety curriculums. NASBLA has also developed a model PWC boating course. This course outline may be used by the individual States to pattern the courses they develop, and it serves as a guide to educational organizations that work within the local communities to provide training. In addition to NASBLA's education efforts, the Personal Watercraft Industry Association (PWIA) has also been developing model PWC education requirements. PWIA advocates mandatory education for PWC operators and has mandatory education as an element of its model legislation.

⁹ The following States and Territories require PWC education: Colorado, Connecticut, Delaware, Georgia, Idaho, Kansas, Massachusetts, Minnesota, Nevada, Rhode Island, Tennessee, Texas, Utah, Wisconsin, U.S. Virgin Islands, and American Samoa. Nevada requires PWC education only of PWC operators who rent the vessel. (National Association of State Boating Law Administrators. 1997. Reference guide to State boating laws. 3d ed. Lexington, KY (p. 21). 182 p., plus appendixes.)

¹⁰ Michigan's course is only 1 hour long; most States require 6 to 8 hours of classroom instruction.

¹¹ *Small Craft Advisory*. Dec. 1997/Jan. 1998. Lexington, KY: National Association of State Boating Law Administrators; 13(2): 20.

¹² Federal Register, Vol. 63, No. 54, dated March 20, 1998, page 13585.

PWC manufacturers provide safety information in printed and video formats with every PWC sold, and dealers are asked to review these safety techniques with customers. The PWIA has also developed classroom material used in several State safety education courses. One manufacturer recently introduced a PWC training program that requires dealers to deliver a boating safety presentation (video and law review) to all purchasers of new PWC.¹³ The product cannot be warranty-registered until the customer receives the information. The Safety Board commends industry efforts to provide PWC owners with point-of-purchase education and training. However, this point-of-purchase information may not reach relatives and friends of the PWC owner who may use the vessel. In its 1993 study on recreational boating, the Safety Board recommended that each State

Implement minimum recreational boating safety standards to reduce the number and severity of accidents; consider requirements such as mandatory use of personal flotation devices for children, demonstration of operator knowledge of safe boating rules and skills, and operator licensing. (M-93-1).¹⁴

Although some progress has been made in responding to the Safety Board's recommendation, as shown by the 4 States that now require boater certification and the 20 that mandate boating education, the Safety Board continues to believe that if more recreational boaters were trained, the number of persons killed and injured in recreational boating accidents, including those involving PWC, would be reduced. Therefore, the Safety Board is reiterating Safety Recommendation M-93-1. Because two-thirds of PWC owners also owned a powerboat prior to purchasing a PWC,¹⁵ it is reasonable to believe that powerboat operators taking a recreational boating education course may someday be PWC owners or operators. To reach the maximum number of persons who may operate a privately owned PWC, recreational boating education courses should provide some level of PWC training. This is not to say that all boaters should take a PWC course, but rather that all recreational boating courses should address PWC safety issues. Therefore, the Safety Board believes that the States, the Coast Guard Auxiliary, the U.S. Power Squadrons, BOAT/U.S., and NASBLA should include information on the safe operation of PWC in all recreational boating courses.

The Safety Board is concerned about persons who rent PWC. Nearly one-quarter of the PWC operators involved in the accidents analyzed by the Safety Board for this study (292 of 1,218, or 24 percent) were operating rented PWC.¹⁶ Accident case analysis showed that 68 percent of the operators of rented PWC were under age 25, and 73 percent had been riding less

¹³ Polaris Industries, Inc.

¹⁴ Safety Recommendation M-93-1 has been classified "Closed—Acceptable Action" for 7 States, "Open—Acceptable Response" for 28 States, "Open—Response Received" for 4 States, "Open—Awaiting Response" for 9 States, and "Closed—Unacceptable Action" for 4 States.

¹⁵ Bowe Marketing Research. 1996. PWIA owner usage, attitude, and demographic research. Survey of PWC owners commissioned by the PWIA and presented at the PWIA Board of Directors meeting July 23, 1996.

¹⁶ Boating accident report forms of all States contain a field to designate whether or not the vessel was rented. Rental information was provided for 85 percent (1,034 of the 1,218) of the PWC operators involved in the accidents that occurred during the January–June 1997 study period.

than 1 hour at the time of the accident; 84 percent of the accidents involved collision with another vessel.

There was limited reporting of PWC renters who received safety information (110 of 292 rentals), but for those for whom the information was reported, the safety information was usually transmitted by verbal instruction (56 percent). Only one out of three PWC renters included in the Safety Board's accident analysis indicated that the rental agent had required them to demonstrate PWC riding ability. To encourage all rental businesses to be responsible partners in safe boating, the PWIA provides a free education package for PWC rental businesses. The package includes a videotape, waterproof checklist, safety posters, and safety literature.

Nearly half of the rented PWC in the Safety Board's accident sample were operated by out-of-state residents. If the PWC was rented, 48 percent of the operators reported were not State residents (132 of 277); for nonrented PWC, only 11 percent of the accident operators resided outside the State (80 of 757). Out-of-state operators may be less familiar with the recreational waterways in which they are operating the PWC and with the local boating regulations.

Operators of rented PWC were twice as likely as operators of personally owned PWC to have ridden the vessel less than 1 hour before the accident occurred. The Board's review of the data indicate that 73 percent of rental-operator accidents occurred within the first hour of operation (102 of 139) compared with 39 percent for nonrental operators (107 of 272). However, this finding may be confounded by the fact that PWC are rented by the hour and some portion of renters will rent the vessels for only an hour. About half of the operators of rented PWC had previously operated a PWC only once or never; this underscores the need for PWC education and training.

Reported causes of the accidents involving rented PWC appeared to show a somewhat different pattern than nonrented PWC. Operators of rented PWC were somewhat more likely to have accidents reported as resulting from inexperience and inattention, but they were not as likely to have an accident reported as resulting from inappropriate speed for the operating conditions.

Twenty States have taken steps to address the safety of PWC rental operations. For example, in Oregon and Florida, the minimum age (by statute) to operate a PWC is 14, but it is 16 for operators who rent PWC. In Wisconsin, the allowable operating age with training and adult supervision is 12, but 16 for those who rent a vessel. Idaho law effective July 1996 specifically requires all rental businesses and agents to educate all PWC renters concerning the safe operation of the vessel and to place a decal on the vessel that lists safe operating techniques and boating laws. The law requires the renter to take the education (PWC video and instruction provided at the point of rental) and to carry an acknowledgment-of-education form while operating the PWC. Violation is an infraction of the law. Florida requires an on-water checkride to be provided by rental agents. Nevada requires not only the renter, but each person who will operate under the rental contract, to receive instruction in the laws and safe operation of the PWC. A dozen States specify education or training requirements that rental agents must provide PWC renters.

Accident data showed that operators of rented PWC in the study sample had less PWC experience than did operators of privately owned personal watercraft. Considering the unique operating characteristics of PWC, this lack of experience creates a safety risk. Given that the percentage of PWC accidents that occur within the first hour was almost twice as high for rented PWC as for nonrented PWC (73 percent compared to 39 percent), that half of the accident-involved rental operators had limited or no experience on a PWC, and that about two-thirds of accident-involved PWC renters had not had to demonstrate their ability to operate the vessel, the Safety Board believes that States should enact or revise their recreational boating laws, as necessary, to require rental businesses to provide safety instruction training to all persons who operate rented PWC; all the operators should be required to demonstrate their ability to operate and control personal watercraft. The Safety Board is also recommending that NASBLA, in conjunction with the Coast Guard and the PWIA, develop a checklist for boat rental businesses to use for evaluating a person's ability to operate a personal watercraft.

Personal Flotation Devices

The Safety Board's accident analysis showed that 97 percent of the PWC operators (971 of 999 reported) were wearing a personal flotation device (PFD). Most operators (80 percent, or 425 of 534 reported) wore a type III flotation aid life jacket. Personal watercraft are the only type of recreational vessel for which the leading cause of death is not drowning; however, when drowning is involved, it is typically because the rider was not wearing a PFD. According to Coast Guard data for 1995, 38 percent of PWC fatalities were from drowning (26 of 68); 20 of the 26 persons who drowned were not wearing a PFD. In 1996, PWC fatalities from drowning decreased to 15 (of 57 PWC fatalities); however, 10 of the 15 who drowned were not wearing a PFD.

The Safety Board concludes that the high usage of personal flotation devices among PWC riders in the study sample was reflected in the low number of PWC fatalities who drowned. Because most PWC operators who drown are not wearing a PFD, PWC operators should be required to wear a personal flotation device. For 45 States and Territories, operating a PWC is a specific circumstance that requires the wearing of a PFD. Two additional States (Vermont and Alaska) have PFD requirements for use on an open deck, which would include PWC. Nine jurisdictions have not defined requirements for wearing PFDs while riding a PWC. The Safety Board believes that these jurisdictions (California, Hawaii, Idaho, Mississippi, Nebraska, New Mexico, Puerto Rico, and the District of Columbia) should enact legislation to require the use of a PFD while operating PWC.

Therefore, the National Transportation Safety Board recommends that all States and Territories:

Include information on the safe operation of personal watercraft in all recreational boating courses. (M-98-100)

Enact or revise your recreational boating laws, as necessary, to require rental businesses to provide safety instruction training to all persons who operate rented personal watercraft; all the operators should be required to demonstrate their ability to operate and control a personal watercraft. (M-98-101)

The National Transportation Safety Board further recommends that California, Hawaii, Idaho, Mississippi, Nebraska, New Mexico, Puerto Rico, and the District of Columbia:

Enact legislation to require the use of a personal flotation device while operating personal watercraft. (M-98-102).

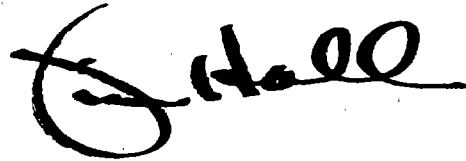
Also as a result of this safety study, the Safety Board reiterates the following recommendation to 42 States and Territories for which the recommendation is in an "Open" status (Alaska, Arkansas, California, Connecticut, Georgia, Idaho, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, Montana, Nebraska, Nevada, New Hampshire, New Jersey, New Mexico, North Carolina, North Dakota, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, Tennessee, Texas, Utah, Virginia, Washington, West Virginia, Wisconsin, the District of Columbia, Puerto Rico, and the Virgin Islands):

Implement minimum recreational boating safety standards to reduce the number and severity of accidents; consider requirements such as mandatory use of personal flotation devices for children, demonstration of operator knowledge of safety boating rules and skills, and operator licensing. (M-93-1)

As a result of this study, the Safety Board issued additional safety recommendations to the manufacturers of personal watercraft (Kawaski, Yamaha, Polaris, Bombardier, and Arctic Cat, Inc./Tiger Shark), the U.S. Coast Guard, the U.S. Coast Guard Auxiliary, the Personal Watercraft Industry Association, the U.S. Power Squadrons, BOAT/U.S., and the National Association of State Boating Law Administrators.

The National Transportation Safety Board is an independent Federal agency with the statutory responsibility "...to promote transportation safety by conducting independent accident investigations and by formulating safety improvement recommendations" (Public Law 93-633). The Safety Board is vitally interested in any actions taken as a result of its safety recommendations and would appreciate a response from you regarding action taken or contemplated with respect to the recommendations in this letter. Please refer to Safety Recommendations M-98-100 and -101 and, if applicable, M-98-102 and M-93-1 in your reply.

Chairman HALL, Vice Chairman FRANCIS, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in these recommendations.

A handwritten signature in black ink, appearing to read "Jim Hall", written in a cursive style.

By: Jim Hall
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St. Thomas, Virgin Islands 00801



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: June 5, 1998

In reply refer to: R-98-17

Ms. Jolene M. Molitoris
Administrator
Federal Railroad Administration
400 7th Street, S.W.
Washington, D.C. 20590

At approximately 8:00 p.m., mountain standard time, on January 27, 1997, Apache Railway¹ train APA No. 81 derailed 46 cars, 2 miles south of Holbrook, Arizona.² The 46 cars were part of a 78-car train. The crew was removing one car from the train, when the remaining 77 cars of the train rolled 14 miles down a 1.7-percent descending grade and derailed on a 6-degree curve. Two tank cars were involved in the derailment. One tank car containing hydrogen peroxide was compromised and released its entire contents. A fire ignited in the wreckage; it was generally confined to cars containing recycled waste paper. Local emergency responders evacuated 150 people from a nearby residential area until the morning of January 28, 1997.³ There were no fatalities or injuries. The estimated damage was \$2.06 million.

The Safety Board investigation revealed that the train rolled away unattended because the conductor had trapped the air in the train braking system, an action referred to as "bottling the air." Bottling the air can cause an undesired release of the brakes on a standing train.

The Apache Railway, like most railroads in the United States, has specific rules prohibiting this action. The Federal Railroad Administration (FRA), however, does not have a regulation specifically prohibiting railroad employees from bottling the air on a standing train.

¹ The Apache Railway is owned by the Stone Container Company (paper products). The 44 miles of railroad creates a connection between the Burlington Northern Santa Fe Railroad's mainline at Holbrook, Arizona, and the Stone Container Company's paper mill at Snowflake, Arizona. Primary traffic on the railroad are inbound and outbound bulk commodities.

² For additional information read Railroad Accident Brief—*Derailed of Apache Railway Company Train, Holbrook, Arizona, January 27, 1997* (LAX97FR005); copy enclosed.

³ The primary reason for the evacuation was excessive smoke, which hindered the abilities of the local responders from being able to determine the products involved.

Since 1989, the Safety Board has investigated five accidents in which the probable cause was determined to be an employee bottling the air. Total cost to the railroads for those cases has been more than \$8 million.⁴

Furthermore, FRA statistics show that in 1994, six accidents were attributed to an employee bottling the air and in 1995, another four accidents resulted from this practice.⁵ Together, these accidents cost an additional \$600,00 in damages.

Thus, the accident history indicates that operating rules alone are insufficient to prevent a railroad employee from using this procedure. To hold operating crews more accountable for their actions and to deter railroad employees from using this procedure, the Safety Board believes that the FRA should incorporate a specific prohibition against bottling the air in the Code of Federal Regulations.

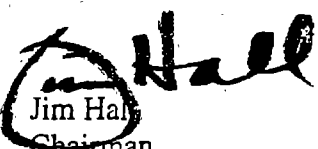
Therefore, the National Transportation Safety Board recommends that the Federal Railroad Administration:

Issue a regulation that requires the brake pipe pressure to be depleted to zero and an angle cock to remain open on standing railroad equipment that is detached from a locomotive controlling the brake pipe pressure. (R-98-17)

Please refer to Safety Recommendation R-98-17 in your reply. If you need additional information, you may call (202) 314-6430.

Chairman HALL, Vice Chairman FRANCIS, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in this recommendation.

By:


Jim Hall
Chairman

⁴ For more information see Railroad Accident Report—*Collision and Derailment of Montana Rail Link Freight Train with Locomotive Unit and Hazardous Materials Release, Helena, Montana, February 2, 1989* (NTSB/RAR-89-05); Railroad Accident Reports—*Brief Format of 1990 Accidents* (NTSB/RAB-93/01) Spokane, Washington, Accident, April 29, 1990, p. 88; Railroad Accident Reports—*Brief Format of 1991 Accidents* (NTSB/RAB-93/02) Waterfall, Wyoming, Accident, March 4, 1991, p. 34; Railroad Accident Reports—*Brief Format of 1993 Accidents* (NTSB/RAB-96/02) Hudson, Colorado, Accident, August 11, 1993, p. 95, and Dubuque, Iowa, Accident, December 21, 1993, p. 155.

⁵ U.S. Department of Transportation, Federal Railroad Administration, *Accident/Incident Bulletin No. 163 Calendar Year 1994*, August 1995, and *Accident/Incident Bulletin No. 164 Calendar Year 1995*, August 1996.

NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C.

**LAX 97 FR 005
DERAILMENT
APACHE RAILWAY COMPANY
HOLBROOK, ARIZONA
JANUARY 27, 1997**

At approximately 8:00 p.m., mountain standard time, on January 27, 1997, Apache Railway train APA No. 81 derailed 46 cars, 2 miles south of Holbrook, Arizona. The 46 cars were part of a 78-car train. The crew was removing one car from the train when the remainder of the train rolled down a 1.7-percent descending grade, finally derailling on a 6-degree curve. Two tank cars derailed. One tank car containing hydrogen peroxide was compromised and released its entire contents. A fire ignited in the wreckage; it was generally confined to cars containing waste paper. Local emergency responders evacuated 150 people from a nearby residential area until the morning of January 28, 1997. There were no fatalities or injuries. Damages were estimated at \$2.06 million.

At 6:25 p.m., train No. 81 had departed Holbrook, Arizona, milepost (MP) 0, on a return trip to the railroad's main yard, 38 miles away. At MP 16, the crew stopped the train to set out one loaded car of feed for a pig farm. The car was five cars behind the engine.

The conductor explained that he turned the angle cock at the rear of the fifth car. Then he said he closed the angle cock at the lead end of the sixth car, which was part of the train that would be left standing on the main track. When the conductor closed the angle cock on the lead end of the sixth car, he trapped the air in the portion of the train that would be left standing. This procedure is commonly called "bottling the air" in the railroad industry and is prohibited by carrier operating rules. Had the conductor not bottled the air, the brakes on the remaining portion of the train would have had an emergency application that would not have been released until the locomotives were reattached.

Later, during the interview with the crew, investigators found that the conductor and engineer had discussed bottling the air before performing the switching. They concluded that when the initial stop at the pig farm was made, it would be important for the engineer to make a heavy brake application on the train before the conductor separated the cars. The conductor and engineer agreed that this heavy brake application should prevent the train from

unintentional movement, even though the air pressure would be trapped in the brake pipe.

When the conductor had completed the necessary tasks to place the rear car onto the side track, he instructed the engineer to back the locomotives and four remaining cars toward the location where the brakeman was waiting on the main track. The rear brakeman boarded the leading end of the fourth car and proceeded toward the location where they had left the train. The brakeman stated that he looked back toward the train they had left on the main track. The train was not there. The brakeman remarked that he notified the engineer that the train was no longer standing where they had left it. The brakeman suggested they increase the speed and maybe they could "catch" the train. When they had gone approximately 1 mile, the brakeman expressed concern that if the free-moving train suddenly stopped, they might collide with it. The brakeman further explained that since he was on the front of the four cars attached to the locomotives, the rear headlight of the locomotives was unavailable to assist in the darkness.

When the conductor closed the angle cock on the remainder of the train, the brake pipe initiated an increase in pressure that propagated back toward the rear of the train and released the brakes. Because the train was standing on an ascending grade, once the brakes were released, the 73 cars rolled away freely. The accident would probably have been avoided if the conductor had left the angle cock open.

PROBABLE CAUSE

The National Transportation Safety Board determines that the probable cause of this accident was the conductor's closing of the angle cock and bottling the air on the remaining portion of the train, which prevented the emergency brakes from being applied. Contributing to the accident was the engineer supporting the actions of the conductor.

Adopted: April 23, 1998



National Transportation Safety Board
Washington, D.C. 20594

Safety Recommendation

Date: June 25, 1998

In Reply Refer To: R-98-18 through -25

Mr. Jerry Davis
President and Chief Executive Officer
Union Pacific Railroad
1416 Dodge Street
Omaha, Nebraska 68179

At 10:52 p.m. on June 22, 1997, Union Pacific Railroad freight trains 5981 North and 9186 South collided head-on in Devine, Texas. The trains were operating on a single main track with passing sidings in dark (nonsignalized) territory in which train movement was governed by conditional track warrant control authority through a dispatcher. The conductor from 5981 North, the engineer from 9186 South, and two unidentified individuals who may have been riding on 5981 North were killed in the derailment and subsequent fire. The engineer from 5981 North received minor injuries, and the conductor from 9186 South was seriously burned. Estimated damages exceeded \$6 million.¹

The National Transportation Safety Board determined that the probable cause of this accident was the failure of the third-shift dispatcher to communicate the correct track warrant information to the traincrew and to verify the accuracy of the read-back information because the UP management had not established and implemented workload policies and operational procedures to ensure a safe dispatching system and the Federal Railroad Administration (FRA) had failed to provide standards and oversight in all aspects of train dispatching operations. Contributing to the accident was the lack of an installed positive train separation control system that would have prevented the trains from colliding by automatically intervening in their operation because of inappropriate actions being taken.

¹For more detailed information, read Railroad Accident Report--*Collision and Derailment of Union Pacific Railroad Freight Trains 5981 North and 9186 South in Devine, Texas, on June 22, 1997* (NTSB/RAR-98/02).

During the issuance of track warrant 8289 to train 9186 South, the third-shift dispatcher failed to accurately communicate the track warrant information in its entirety to the traincrew from his computer screen as it was apparently displayed. He omitted the after-arrival instructions (hold the main track at Gessner until the arrival of train 5981 North) when formally issuing authorization to train 9186 South to proceed from Gessner to Melon. The recorded radio transcripts of the transmission between the dispatcher and the 9186 South traincrew substantiated that the dispatcher did not include the after-arrival instructions of track warrant 8289 to the crew. When the train 9186 South conductor repeated the track warrant back to the dispatcher, the third-shift dispatcher failed to confirm the accuracy of the read-back information from the crew with the display on the computer screen. Had the third-shift dispatcher done so, he would have noted the discrepancy between the track warrant that was displayed on his computer screen and the read-back information and could have corrected the inconsistency and provided the after-arrival instruction (hold the main track at Gessner until the northbound train had passed). Because train 9186 South was not notified to wait for the northbound train to pass at Gessner, it proceeded from Gessner toward the northbound train, which was earlier authorized to proceed and occupy the block of track from Melon to Gessner. Therefore, the Safety Board concluded that the third-shift dispatcher's failure to accurately issue track warrant 8289 to train 9186 South and his failure to detect and correct the 9186 South conductor's repeat of the track warrant authority limit resulted in the crew receiving an incorrect track warrant that allowed the opposing trains 5981 North and 9186 South to operate on the same track in opposite directions through Devine on June 22, 1997.

The third-shift dispatcher had been operating as a qualified dispatcher since August 1996. Most of his experience had been dispatching trains in dark territories, such as the one in which this accident occurred. He had no previous dispatching violations before June 22, 1997. During the 10 months before the Devine accident, the third-shift dispatcher had demonstrated sufficient knowledge of dispatching duties. He had accurately communicated track warrant information to other traincrews during previous and subsequent issuance of track warrants. However, he failed to accurately communicate the track warrant 8289 information to train 9186 South and to validate the line repeat-back from the conductor of that train.

At the time of the Devine accident, the UP verification process of track warrants relied on the train dispatcher to detect an inaccurate read-back message and to ensure that a complete and accurate transmission was received from the traincrew. This verification process, in which the train dispatcher just followed the oral repeat-back received from the crew, did not provide a redundancy feature that would confirm whether an accurate repeat-back of the original transmission had registered with and been noted by the train dispatcher.

On the day of the accident at Devine, the third-shift dispatcher understood that when communicating a track warrant to a traincrew, his primary tasks were to read the information as presented on the screen and verify its accuracy, comparing the oral read-back from the traincrew with the information on the screen; he believed that he had been following the established UP track warrant communication procedures. The Safety Board concluded that the third-shift dispatcher did not communicate the accurate information in track warrant 8289 to the crew of

train 9186 South. Therefore, the Safety Board believes that the UP should evaluate its dispatcher training program and make necessary revisions to place greater emphasis on all safety critical activities including procedures used to issue and confirm track warrants.

The third-shift dispatcher stated that on the night of the accident, his workload was "probably an average night for that position" and that from the start of his shift, he had received several radio calls and "it was busy." Immediately after the shift changeover, he had to process the information just received from the departing dispatcher and prioritize the tasks that he was to perform during the shift. That night the dispatcher's first task was a radio transmission with a delayed Amtrak train still on his territory, which was a rare occurrence for the beginning of this shift. Immediately after this, he turned his attention toward dispatching the UP trains and spent the majority of his initial time on the radio.

The third-shift dispatcher issued the incomplete track warrant information to the crew of train 9186 South within the first 10 minutes of his shift. Veteran dispatchers at the Harriman Dispatch Center (HDC) reported that the most difficult time of a shift is the first 30 minutes, when a dispatcher is "trying to assimilate everything" and mentally planning the operation of the territory. The Safety Board examined the UP dispatcher rule violations data and found that approximately 30 percent of the violations occurred within the first hour after the start of a new, 8-hour shift, particularly on territories of high-operating demands. The Safety Board concluded that the UP dispatchers' elevated workload at the beginning of shifts may contribute to the disproportionately greater number of dispatching violations occurring during this time. Therefore, the Safety Board believes that the UP should conduct an audit of its train dispatching operations to identify specific factors that can lead to dispatching errors and include in the audit and assessment of dispatching errors that occur during or shortly after shift changes or because of improper radio procedures.

The Safety Board is concerned that an error similar to the one committed by the third-shift dispatcher was also committed by two other dispatchers, all of whom were trained in the year before the June 22, 1997, accident. The third-shift dispatcher, although reporting that he believed his training was adequate, stated, "How can training be equal to . . . a dozen radios going off and ten people yelling at you at the same time. . . . Having to deal with that sort of thing is hard." The Safety Board therefore examined the challenges faced by less experienced dispatchers operating in territories of high-operating demands.

Many of the territories to which less experienced dispatchers are initially assigned, such as the Austin subdivision, have nearly doubled in train volume since the early 1990s, when they may have been more easily dispatched because of the fewer trains operating. Such territories often pose operational challenges to even the most experienced dispatchers. Veteran dispatchers reported that under conditions of high-operating demands, less experienced dispatchers may issue track warrants while mentally or physically attending to their next task and not concentrating on the read-back communication from the train crewmembers. The FRA noted during its safety audit of the HDC that dispatchers working under high-workload conditions were not consistently monitoring the computer screens during read-backs of track warrants because of

other task demands, which included answering the telephone, communicating with other dispatchers, and reading lineups and performing transfers with their relief shift dispatchers. Some dispatchers, as a result, may forgo safe dispatching practices in an attempt to manage the high-operating demands.

The Safety Board is concerned that newly qualified dispatchers initially assigned to territories of high-operating demands may not have the opportunity to refine their skills to increase their dispatching efficiency. Rudimentary skills taught to apprentice dispatchers in the initial training program can be further developed as they operate in territories of moderate-operating demands. Those assigned to territories of high-operating demands who have not developed critical skills and strategies to operate efficiently may relinquish safe procedures to manage the high-operating demands. The box 7 after-arrival errors committed by the newly qualified dispatchers were the result of their omitting track warrant verification procedures, perhaps as a means to manage their dispatching duties. The Safety Board concluded that some UP apprentice dispatchers may not have been adequately prepared to be placed and operate safely in territories of high-operating demands immediately after completing the training program.

The majority of all HDC dispatching errors for dispatchers occur in territories of high-operating demands. As train volume increases, the workload demands on the dispatcher likewise increase. The Safety Board is thus concerned that for both veteran and newly qualified dispatchers, the need to manage the steady increase in train traffic may jeopardize their ability to attend to all critical tasks and to dispatch trains safely.

The UP has a study under way to determine which territories on its system pose the highest operating demands on its dispatchers. Several operational factors are being assessed, including the train volume, the number of track warrants issued, and the amount of time spent issuing track warrants. The Safety Board notes that this assessment is a critical step in determining where the greatest challenges are for the UP dispatchers but advises that a comprehensive evaluation of operational demands in a given territory needs to consider both the task and the knowledge, skill, and ability of the dispatchers, including the level of task demands, the operator's mental and physical capacity, the work strategy, and the skill level.² For instance, one UP dispatcher with many years of experience indicated that handling 18 trains on his territory was not difficult for him; however, a less experienced dispatcher working the same territory felt overloaded by the dispatching demands. The Devine accident demonstrates that not all qualified dispatchers are equally prepared to manage similar operating demands. The errors committed by qualified, but less experienced, dispatchers strongly indicate a need for careful consideration of the placement of dispatchers in territories of high-operating demands. The Safety Board believes that the UP should conduct an audit of its train dispatchers' activities to evaluate the current workload and

²Welford, A.T., "Mental Workload as a Function of Demand, Capacity, and Skill," *Ergonomics*, 21, 1978, pp. 151-167.

should make necessary changes to dispatcher operations to distribute workload based on the individual dispatcher's qualifications, ability, and experience.

Although the UP had a policy that an apprentice dispatcher became a qualified dispatcher only with the full agreement of several officials involved in the training process and would be provided training until ready to work the position, the Safety Board found some instances in which these standards were not being upheld by management. Dispatchers indicated that management has qualified apprentice dispatchers despite opposition from some on-the-job training (OJT) dispatcher trainers involved in the training process, and dispatchers believed that the qualifying process has been compromised to expedite the placement of new dispatchers in the dispatching operations. The Safety Board concluded that the UP may have jeopardized safe dispatching operations by qualifying unprepared apprentice dispatchers and assigning less experienced dispatchers to territories of high-operating demands.

Another area in which the UP did not adhere to its policies was in upholding the experience level of OJT dispatcher trainers for apprentice dispatchers. The UP management reported that qualified dispatchers responsible for conducting the OJT for apprentice dispatchers must have at least 5 years of dispatching experience. According to UP dispatchers, however, dispatchers with less than 5 years of experience were training apprentice dispatchers. Some veteran dispatchers believed that 5 years should be the minimum experience level for an OJT dispatcher trainer. Since the accident at Devine, the UP has increased to 10 years the minimum experience level for the OJT dispatcher trainers. The Safety Board has learned from the UP dispatcher data that fewer than half of the UP dispatchers have attained this experience level and concluded that because the UP did not meet its 5-year experience standard for OJT dispatcher trainers, complying with the higher standard of a minimum 10-year experience level for OJT dispatcher trainers may not be achieved. Therefore, the Safety Board believes that the UP should examine the circumstances in which its policy to require a minimum 5 years of experience to qualify as an OJT dispatcher trainer was not followed and take action to ensure that its qualification policies are followed.

Like many other railroads, the UP had no formal training or procedures for the dispatcher trainers who oversee the apprentice dispatchers during OJT. The FRA reported that in many railroads the OJT had been delegated to subordinates without adequate direction, control, or evaluation methods, which led to unstructured and inconsistent training. Although the FRA found no evidence during its reviews that inadequate dispatcher training directly resulted in train accidents, it noted that training directly impacts train dispatcher efficiency and productivity, which can impact safety. Additionally, the lack of well-defined training may contribute to train dispatcher stress and fatigue, as well as work overload. The Safety Board concurs with the FRA's position. Therefore, the Safety Board believes that the UP should develop and implement a comprehensive program to select and train experienced dispatchers to serve as dispatcher trainers.

The safety of the system is directly dependent on the appropriate actions of those operating in safety-sensitive areas. Management has a responsibility to establish an operating environment most conducive to safe operations. The Safety Board examined the UP management efforts to

ensure a safe and efficient operating environment for the dispatchers. Although the UP policies do address many critical safety-sensitive areas, the Safety Board has identified areas in which actual company practice has fallen short of company standards. The Safety Board understands that apprentice dispatchers have become qualified dispatchers without the concurrence of OJT dispatcher trainers or the apprentice dispatcher trainee. Newly qualified dispatchers have been placed in territories of high-operating demands without the benefit of developing skills through experience. By failing to accommodate the needs of less experienced dispatchers and by not adhering to its own standards, the UP failed to create an environment conducive to safe dispatching operations. Consequently, the Safety Board concluded that the third-shift dispatcher's failure to communicate the information in track warrant 8289 accurately to the 9186 South traincrew and to verify the accuracy of the read-back information resulted from operational shortcomings at the HDC.

The UP company policy did not require that corridor managers have previous dispatching experience, and some did not. Although during normal operations this typically does not pose a problem, dispatchers expressed frustration with what they perceived as poor decisions by some corridor managers during more complex operating situations. Dispatchers reported that during the daily safety and production meetings, some corridor managers lent support to the dispatchers' workload challenges on their territories, and other corridor managers were not interested in discussing the problems experienced by the dispatchers. As a result, dispatchers sought advice from other sources, such as upper management officials, when confronting certain complex situations. The Safety Board concluded that some UP corridor managers did not consistently provide appropriate technical support to the train dispatchers. Therefore, the Safety Board believes that the UP should evaluate and determine the technical expertise required of corridor managers and make the necessary changes to ensure that corridor managers are qualified to provide proper dispatching assistance to the train dispatchers.

The UP train dispatchers also expressed concern about the noise level originating from adjacent dispatching stations at the HDC. The noise level is highest during the shift changeover when the dispatchers brief their replacements about the status of their territories. Waist-high barriers separate dispatchers from each other, but do not block out distracting conversations. Higher partitions, used at some dispatch centers, serve better as sound barriers and provide a quieter working environment. The Safety Board concluded that although no evidence was found that adjacent noises in the dispatching area contributed to the third-shift dispatcher's inattention to the track warrant 8289 information in the Devine accident, a dispatcher's performance may be affected by unnecessary, avoidable sound distractions. Therefore, the Safety Board believes that the UP should identify all distractions, evaluate their effects on dispatchers, and take action to establish a working environment conducive to safe dispatching operations.

The use of after-arrival instructions creates an inherent danger by giving a traincrew conditional authority, under which, if a condition is met, their train is allowed to proceed into a block of track even though that track is occupied by an opposing train. (In the Devine accident, the condition was the physical passing of another train.) Should a failure occur in the transmission or comprehension of a track warrant that results in the omission or inaccurate

communication of the condition, two opposing trains may occupy the same block of track at the same time. Once an error has occurred in dark territory and two trains are on the same track at the same time, no wayside signals are available to warn one train of the presence of the other.

The Safety Board has investigated other railroad accidents in which the avoidance of a collision depended on the use of a rule or standard operating practice that proved to be insufficient to prevent an accident. In the Devine accident, the third-shift dispatcher failed to adhere to procedural policy and to follow verbatim the read-back message from the traincrew. The system employed by the UP at the time of the Devine accident allowed for such a failure to occur and permitted the third-shift dispatcher to overlook a critical element during the issuance of track warrant 8289. Hence, the UP method used for dark territory operations needs to be revised to ensure that an oversight by a dispatcher cannot occur. The Safety Board concluded that had the UP after-arrival system in dark territory operations not been used in the Devine accident area, the opposing trains 5981 North and 9186 South would not have been occupying the same block of track. Therefore, the Safety Board believes that the UP should discontinue permanently the use of after-arrival orders in dark (nonsignalized) territory.

Therefore, the National Transportation Safety Board recommends that the Union Pacific Railroad:

Evaluate your dispatcher training program and make necessary revisions to place greater emphasis on all safety critical activities including procedures used to issue and confirm track warrants. (R-98-18)

Conduct an audit of your train dispatching operations to identify specific factors that can lead to dispatching errors and include in the audit an assessment of dispatching errors that occur during or shortly after shift changes or because of improper radio procedures. (R-98-19)

Conduct an audit of your train dispatchers' activities to evaluate the current workload and make necessary changes to dispatcher operations to distribute workload based on the individual dispatcher's qualifications, ability, and experience. (R-98-20)

Examine the circumstances in which your policy to require a minimum 5 years of experience to qualify as an OJT dispatcher trainer was not followed and take action to ensure that your qualification policies are followed. (R-98-21)

Develop and implement a comprehensive program to select and train experienced dispatchers to serve as dispatcher trainers. (R-98-22)

Evaluate and determine the technical expertise required of corridor managers and make the necessary changes to ensure that corridor managers are qualified to provide proper dispatching assistance to the train dispatchers. (R-98-23)

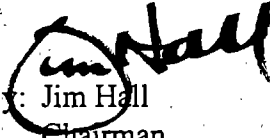
Identify all distractions, evaluate their effects on dispatchers, and take action to establish a working environment conducive to safe dispatching operations. (R-98-24)

Discontinue permanently the use of after-arrival orders in dark (nonsignalized) territory. (R-98-25)

In addition, the Safety Board issued Safety Recommendations R-98-26 through -30 to the FRA and Safety Recommendation R-98-31 to the Texas Railroad Commission. The Safety Board also reiterated Safety Recommendation R-87-16 to the FRA.

The National Transportation Safety Board is an independent Federal agency with the statutory responsibility "to promote transportation safety by conducting independent accident investigations and by formulating safety improvement recommendations" (Public Law 93-633). The Safety Board is vitally interested in any action taken as a result of its safety recommendations. Therefore, it would appreciate a response from you regarding action taken or contemplated with respect to the recommendations in this letter. Please refer to Safety Recommendations R-98-18 through -25 in your reply. If you need additional information, you may call (202) 314-6430.

Chairman HALL, Vice Chairman FRANCIS, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in these recommendations.


By: Jim Hall
Chairman



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: June 25, 1998

In Reply Refer To: R-98-26 through -30

Honorable Jolene M. Molitoris
Administrator
Federal Railroad Administration
Washington, D.C. 20590

At 10:52 p.m. on June 22, 1997, Union Pacific Railroad (UP) freight trains 5981 North and 9186 South collided head-on in Devine, Texas. The trains were operating on a single main track with passing sidings in dark (nonsignalized) territory in which train movement was governed by conditional track warrant control authority through a dispatcher. The conductor from 5981 North, the engineer from 9186 South, and two unidentified individuals who may have been riding on 5981 North were killed in the derailment and subsequent fire. The engineer from 5981 North received minor injuries, and the conductor from 9186 South was seriously burned. Estimated damages exceeded \$6 million.¹

The National Transportation Safety Board determined that the probable cause of this accident was the failure of the third-shift dispatcher to communicate the correct track warrant information to the traincrew and to verify the accuracy of the read-back information because the UP management had not established and implemented workload policies and operational procedures to ensure a safe dispatching system and the Federal Railroad Administration had failed to provide standards and oversight in all aspects of train dispatching operations. Contributing to the accident was the lack of an installed positive train separation control system that would have prevented the trains from colliding by automatically intervening in their operation because of inappropriate actions being taken.

¹For more detailed information, read Railroad Accident Report--*Collision and Derailment of Union Pacific Railroad Freight Trains 5981 North and 9186 South in Devine, Texas, on June 22, 1997* (NTSB/RAR-98/02).

At the time of the Devine accident, the UP verification process of track warrants relied on the train dispatcher to detect an inaccurate read-back message and to ensure that a complete and accurate transmission was received from the traincrew. This verification process, in which the train dispatcher just followed the oral repeat-back received from the crew, did not provide a redundancy feature that would confirm whether an accurate repeat-back of the original transmission had registered with and been noted by the train dispatcher.

On the day of the accident at Devine, the third-shift dispatcher understood that when communicating a track warrant to a traincrew, his primary tasks were to read the information as presented on the screen and verify its accuracy, comparing the oral read-back from the traincrew with the information on the screen; he believed that he had been following the established UP track warrant communication procedures. The Safety Board concluded that the third-shift dispatcher did not communicate the accurate information in track warrant 8289 to the crew of train 9186 South. Track warrants have not been addressed in the Code of Federal Regulations (CFR) and, therefore, their use as a method of operation for train movement has not been federally directed. The Safety Board believes that the FRA should revise 49 CFR 220 to address track warrants and other current railroad operating practices.

The use of after-arrival instructions creates an inherent danger by giving a traincrew conditional authority, under which, if a condition is met, their train is allowed to proceed into a block of track even though that track is occupied by an opposing train. Should a failure occur in the transmission or comprehension of a track warrant that results in the omission or inaccurate communication of the condition, two opposing trains may occupy the same block of track at the same time. Once an error has occurred in dark territory and two trains are on the same track at the same time, no wayside signals are available to warn one train of the presence of the other.

The Safety Board has investigated other railroad accidents in which the avoidance of a collision depended on the use of a rule or standard operating practice that proved to be insufficient to prevent an accident. In the Devine accident, the third-shift dispatcher failed to adhere to procedural policy and to follow verbatim the read-back message from the traincrew. The system employed by the UP at the time of the Devine accident allowed for such a failure to occur and permitted the third-shift dispatcher to overlook a critical element during the issuance of track warrant 8289. Hence, the UP method used for dark territory operations needs to be revised to ensure that an oversight by a dispatcher cannot occur. The Safety Board concluded that had the UP after-arrival system in dark territory operations not been used in the Devine accident area, the opposing trains 5981 North and 9186 South would not have been occupying the same block of track. The Safety Board believes that the FRA should require railroads to discontinue permanently the use of after-arrival orders in dark territory.

The Safety Board has previously examined the FRA oversight of train dispatching. After the Safety Board investigated the derailment of an Amtrak train at Fall River, Wisconsin,² in October 1986, it urged the FRA to:

Conduct a thorough study of the selection process, training, duties, and responsibilities of train dispatchers to determine whether the workload is beyond the normal job stress level and to determine what selection and training standards are used for train dispatchers. Establish selection and training standards and limits of workload for dispatchers. (R-87-66)

In 1990, the FRA reported to the U.S. Congress that the imposition of Federal training standards for train dispatchers was not necessary. The FRA based its judgment on a number of factors that it found during the FRA nationwide review of train dispatching.

In a September 1991 letter to the Safety Board, the FRA wrote of its intent to implement a formal research and development study of dispatcher training programs, workload measurement models, occupational stresses, and fatigue effects. The FRA stated in January 1995 that it had found that train dispatchers continue to provide safe, efficient service to the industry; however, it believed that several dispatching areas, particularly training and testing, had shortcomings. In February 1995, the Safety Board advised the FRA that it was disappointed that many of the study's findings and concerns were not adequately addressed in the published recommendations for action. For example, the study identified several major safety-related problems in the occupational stress, workload, and environmental policies affecting dispatchers, but the FRA still has not completed satisfactory regulatory activity to establish dispatcher standards. Therefore, the Safety Board concluded that the FRA has failed to develop dispatcher standards and needs to accelerate the establishment of regulatory standards for train dispatchers.

Because the FRA has only partially met the intent of Safety Recommendation R-87-66 by conducting a study of the selection process, training, duties, and responsibilities of train dispatchers, the Safety Board is classifying Safety Recommendation R-87-66 "Closed--Unacceptable Action/Superseded" and issuing a new safety recommendation to the FRA. The Safety Board believes that the FRA should develop and establish dispatcher selection and training standards, dispatcher trainer standards, and workload limits for dispatchers by January 1, 2000.

During its investigation of a train collision that occurred in July 1988, near Altoona, Iowa,³ the Safety Board examined the FRA's surveillance and enforcement of compliance with Federal regulations. The Safety Board cited the FRA as contributing to the cause of the Altoona accident

²For more information, see Railroad Accident Report--*Derailed of Amtrak Passenger Train 8 Operating on the Soo Line Railroad, Fall River, Wisconsin, on October 9, 1986* (NTSB/RAR-87/06).

³For more information, see Railroad Accident Report--*Head-On Collision between Iowa Interstate Railroad Extra 470 West and Extra 406 East with Release of Hazardous Materials near Altoona, Iowa, July 30, 1988* (NTSB/RAR-89/04).

because of the inadequate FRA surveillance and enforcement of compliance with Federal regulations.

The Safety Board investigated an earlier accident having similar circumstances as those that occurred in the June 1997 Devine accident. In August 1991, near Ledger, Montana,⁴ a Burlington Northern Railroad Company (BNSF)⁵ train was operating in dark territory, and the radio transmission for authority to the main track was improperly delivered. The train dispatcher failed to detect an improper read-back from the crew in the field. In the Ledger accident, the train dispatcher did not detect the crew's misreading of a train station when the crew read the track warrant back to the train dispatcher. Thus, two trains had authority to proceed to the same block of track from opposite directions at the same time. The trains collided head-on and three crewmembers were fatally injured.

After its investigation of the Ledger head-on collision between the two BNSF freight trains, the Safety Board found that several procedural dispatching errors occurred during the train radio transmissions that precipitated the accident. Three years before the Ledger accident, the FRA, in its *National Train Dispatcher Safety Assessment of 1987-88*, had recommended that the BNSF immediately implement a program for dispatchers to teach and enforce radio procedures that comply with all applicable Federal and carrier radio rules. The Safety Board found that had either the FRA or the BNSF adequately followed up on the recommendations to the BNSF, the Ledger accident would not have happened.

Following the June 1997 Devine accident, the FRA documented significant dispatcher procedural deficiencies at the UP Harriman Dispatch Center (HDC) in Omaha, Nebraska, that had preexisted that accident. Although the FRA had in place a routine operating practices oversight program for the HDC, the FRA has no record that its previous routine inspections had cited these dispatcher procedural deficiencies. The Safety Board concluded that the FRA's surveillance and enforcement of compliance with Federal regulations at the HDC before the Devine accident were inadequate and ineffective. Therefore, the Safety Board believes that the FRA should evaluate its surveillance and enforcement of compliance with Federal regulations at dispatching centers and take appropriate corrective actions to ensure that Federal oversight is adequate and effective.

In its investigations, the Safety Board relies on data recovered from the event recorders to determine train speed, direction of travel, distance, throttle position, brake application, and cab signal aspects, when applicable, before and during an accident. As was demonstrated in the Safety Board's investigation of the February 1996 freight train derailment near Cajon Junction,

⁴For more information, see Railroad Accident Report--*Head-On Collision between Burlington Northern Railroad Freight Trains 602 and 603 near Ledger, Montana, on August 30, 1991* (NTSB/RAR-93/01).

⁵The Burlington Northern Railroad Company and the Atchison, Topeka and Santa Fe Railway Company merged on October 1, 1995, and formed the Burlington Northern and Santa Fe Railway Company.

California,⁶ certain critical data are retrieved only in the event recorder of the lead locomotive unit and not in the event recorders of the trailing units. In the Devine accident, the event recorder data for train 9186 South and the lead locomotive of train 5981 North were destroyed by impact forces or fire, or both, and critical event recorder data were lost that could not be retrieved from the other event recorders.

The Safety Board has investigated other accidents in which the event recorder data were compromised due to impact forces or water or fire exposure. In its Corona, California,⁷ Knox, Indiana,⁸ and Mobile, Alabama,⁹ accident investigations, the Safety Board found that critical operational data were lost because the event recorders were not crashworthy. Since 1993, when the FRA required the use of locomotive event recorders, the Safety Board has advocated the development of standards for the crashworthiness of these devices.

Three of the five event recorders in the Devine accident were destroyed either from crash forces or fire exposure. The event recorder on the lead locomotive of 5981 North was destroyed by damage incurred in the accident. Data were recovered from the event recorders on the two trailing locomotives of 5981 North. The event recorders on the lead locomotive and the trailing locomotive of 9186 South were destroyed in the postaccident fire. From a fire resistance standpoint, the type of encasement employed by the manufacturer did not protect the event recorders from thermal destruction. None of the event recorders on the locomotives were designed to meet crash forces or fire exposure standards. The Safety Board concluded that had the event recorders been designed to withstand crash forces and fire exposure, the three destroyed event recorders would have survived and could have provided data for the investigation.

The Safety Board is familiar with the crashworthiness standards in the aviation industry that require the ability to withstand impact shock forces of 3,500 g¹⁰ and fire exposure at 1,100° F for 1 hour, which allow the retrieval of event recorder data after a catastrophic event occurs to the aircraft. Similar standards are not available in the railroad industry. Although the FRA assured the Safety Board in August 1997 that actions have been taken to develop standards for crashworthiness, no standards have been established. Therefore, the Safety Board believes that the FRA, working with the railroad industry, should develop and implement event recorder crashworthiness standards for all new or rebuilt locomotives by January 1, 2000.

⁶For more information, see Railroad Accident Report--*Derailment of Freight Train H-BALTI-31 Atchison, Topeka and Santa Fe Railway Company near Cajon Junction, California, on February 1, 1996* (NTSB/RAR-96/05).

⁷For more information, see Railroad Accident Report--*Atchison, Topeka and Santa Fe Railway Company (ATSF) Freight Trains ATSF 818 and ATSF 891 on the ASTF Railway in Corona, California, on November 7, 1990* (NTSB/RAR-91/03).

⁸For more information, see Railroad Accident/Incident Summary Report--*Knox, Indiana - September 17, 1991* (NTSB/RAR-92/02/SUM).

⁹For more information, see Railroad Accident Report--*Derailment of Amtrak Train No. 2 on the CSXT Big Bayou Canot Bridge near Mobile, Alabama, on September 22, 1993* (NTSB/RAR-94/01).

¹⁰An acceleration equal to the acceleration of gravity, about 32 feet per second per second.

A positive train separation (PTS) control system can prevent trains from colliding by automatically intervening in the operation of a train when an engineer does not comply with the requirements of a signal indication or operating rules. The Safety Board has long advocated a PTS control system and since 1970¹¹ has issued safety recommendations calling for this preventive measure. Since most train collisions result from human error, a highly effective train control system is needed. Greater security is provided by a train control system capable of intervening should a failure to observe signals and operating rules occur for whatever reason.

Following its investigation of the head-on collision between two BNSF freight trains near Ledger, the Safety Board urged the FRA in July 1993 to:

Establish a firm timetable that includes at a minimum, dates for final development of required advanced train control system hardware, dates for an implementation of a fully developed advanced train control system, and a commitment to a date for having the advanced train control system ready for installation on the general railroad system.
(R-93-12)

The Safety Board classified Safety Recommendation R-93-12 "Open--Acceptable Response" on July 8, 1994, after the FRA took action to seek the "final system definition, migration path, and timetable" for a PTS control system by December 1994.

The Safety Board has investigated numerous train collisions in which the probable cause or contributing cause was the inattention of the traincrew to wayside signals. After its investigation of the Thedford, Nebraska,¹² accident, the Safety Board stated that had a PTS control system been in place, it could have detected that the engineer was not responding appropriately to the signal indications and could have slowed and stopped the train, thus preventing the collision.

The Silver Spring, Maryland, accident¹³ in February 1996 was the latest in a series of collisions that could have been prevented if a PTS control system had been in place. The Safety Board determined that the probable cause of the accident was the apparent failure of the engineer and the traincrew because of multiple distractions to operate their train according to signal indications and the failure of the FRA, the Federal Transit Administration, the Maryland Mass Transit Administration, and the CSX Transportation Inc. . . . to provide a redundant safety system that could compensate for human error. As a result of the Silver Spring accident investigation, the Safety Board reiterated Safety Recommendation R-87-16, which asked the FRA to promulgate Federal standards to require the installation and operation of a train control

¹¹For more information, see Railroad Accident Report--*Head-on Collision Between Penn-Central Trains N-48 and N-49 at Darien, Connecticut, August 20, 1969* (NTSB/RAR-70/03).

¹²For more information, see Railroad Accident Report--*Collision and Derailment Involving Three Burlington Northern Freight Trains near Thedford, Nebraska, on June 8, 1994* (NTSB/RAR-95/03).

¹³For more information, see Railroad Accident Report--*Collision and Derailment of Maryland Rail Commuter MARC Train 286 and National Railroad Passenger Corporation Amtrak Train 29 near Silver Spring, Maryland, on February 16, 1996* (NTSB/RAR-97/02).

system on main line tracks that will provide for positive separation of all trains,¹⁴ and Safety Recommendation R-93-12.

The FRA and the railroad industry share responsibility for the development and implementation of a PTS control system. Under its regulatory authority, the FRA can order a railroad to install a PTS control system. In the Devine accident, a PTS control system could have detected that the 9186 South engineer was not responding appropriately to the track warrant and then have slowed and stopped the train, thus preventing the head-on collision. The Safety Board concluded that had a PTS control system been installed and working in the Devine accident area, the two trains would not have been allowed to enter the same block of track traveling in opposite directions and, as a result, the head-on collision on June 22, 1997, would not have occurred.

Therefore, the National Transportation Safety Board recommends that the Federal Railroad Administration:

Revise 49 Code of Federal Regulations 220 to address track warrants and other current railroad operating practices. (R-98-26)

Require railroads to discontinue permanently the use of after-arrival orders in dark (nonsignalized) territory. (R-98-27)

Develop and establish dispatcher selection and training standards, dispatcher trainer standards, and workload limits for dispatchers by January 1, 2000. (R-98-28)

Evaluate your surveillance and enforcement activities at dispatching centers and take appropriate corrective actions to ensure that Federal oversight is adequate and effective. (R-98-29)

Working with the railroad industry, develop and implement event recorder crashworthiness standards for all new or rebuilt locomotives by January 1, 2000. (R-98-30)

Furthermore, the National Transportation Safety Board reiterates Safety Recommendation R-87-16 to the Federal Railroad Administration:

Promulgate Federal standards to require the installation and operation of a train control system on main line tracks that will provide for positive separation of all trains. (R-87-16)

Also, the Safety Board issued Safety Recommendations R-98-18 through -25 to the UP and Safety Recommendation R-98-31 to the Texas Railroad Commission. If you need additional information, you may call (202) 314-6430.

¹⁴Issued to the FRA in May 1987 after the review of accident investigations since 1967 in which the accidents could have been prevented had a mandated train separation system been in effect.

Chairman HALL, Vice Chairman FRANCIS, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in these recommendations.


By Jim Hall
Chairman



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: June 25, 1998

In Reply Refer To: R-98-31

Mr. Charles R. Matthews
Chairman
Texas Railroad Commission
Post Office Box 12967
Austin, Texas 78711

At 10:52 p.m. on June 22, 1997, Union Pacific Railroad (UP) freight trains 5981 North and 9186 South collided head-on in Devine, Texas. The trains were operating on a single main track with passing sidings in dark (nonsignalized) territory in which train movement was governed by conditional track warrant control authority through a dispatcher. The conductor from 5981 North, the engineer from 9186 South, and two unidentified individuals who may have been riding on 5981 North were killed in the derailment and subsequent fire. The engineer from 5981 North received minor injuries, and the conductor from 9186 South was seriously burned. Estimated damages exceeded \$6 million.

Shortly before 11 p.m. on June 22, a Devine Police Department (DPD) officer, on routine motor patrol near the UP track south of the railroad bridge at milepost 290.4, reported that he observed a passing northbound train, heard a loud explosion sound, and noted that the passing train was rapidly decelerating. Seeing flames and black smoke at the railroad overpass in his rear view mirror, he radioed the DPD dispatch desk, which received the transmission at 10:52 p.m. and notified the Devine Volunteer Fire Department (DVFD) and the DPD with an "all-hands" respond request. Numerous 911 phone calls were also received from concerned residents reporting a loud explosion sound.

For more detailed information, read Railroad Accident Report--*Collision and Derailment of Union Pacific Railroad Freight Trains 5981 North and 9186 South in Devine, Texas, on June 22, 1997* (NTSB/RAR-98/02).

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While driving to the accident scene, the officer who had witnessed the event encountered the engineer of 5981 North, who had been injured after jumping from the northbound train; the engineer indicated that the other train possibly contained hazardous materials. Because the 5981 North engineer had indicated that hazardous materials may have been on board a train, the community disaster plan was implemented, and the Devine Emergency Management Coordinator was dispatched. The Chemical Transportation Emergency Center² was contacted about 11:06 p.m. by the DPD, which also contacted the railroad to request hazardous materials consist information. The UP responded by phone and fax that no hazardous materials products were on board either train.

The firefighting suppression effort continued to focus on the blaze, which reportedly flared several hundred feet high and was seen up to 30 miles away. About 1 a.m. on June 23, the fire had been substantially suppressed, and the DVFD chief directed that all water lines be shut down. About 1:37 a.m., the fire was declared under control.

The 29-member DVFD provides exclusive firefighting support to Devine, a rural community of about 4,000 people. Supplementary firefighting support is available through mutual aid requests to neighboring communities. At the time of the accident, the DVFD fire suppression equipment consisted of two conventional pump trucks (750 gpm and 1000 gpm) and three small support trucks. The DVFD's support apparatus included ladders, nozzles and hoses, lights, self-contained breathing equipment, and a small stock of fire suppression foam.

Within minutes of the collision, a DPD officer, as well as the first fire, rescue, and emergency medical services personnel, had arrived on scene. The chief of the DVFD activated the Incident Command System and assumed control as incident commander. He acted effectively and managed the incident successfully to completion without serious injury to responders, local residents, or officials at the accident site. However, the DVFD did not have access to an adequate amount of fire suppression foam equipment that would have further aided its efforts to mitigate the massive fire that ensued after the collision. Such equipment is not readily available for rural fire departments, although hazardous materials are routinely transported through their jurisdictions. The increase in rail traffic on the San Antonio to Laredo railroad corridor indicates a need for such readily available firefighting equipment to mitigate a fire event such as the one that occurred in the Devine accident. The National Transportation Safety Board concluded that although the local emergency response was timely and adequate, the lack of readily available fire suppression foam equipment showed a need for additional firefighting equipment to mitigate significant fire events. Consequently, the Safety Board believes that the Texas Railroad Commission should develop a system that would make fire suppression foam equipment readily available to emergency management agencies and local rural fire departments for the fighting of hazardous materials fires.

²The center, operated by the Chemical Manufacturers Association, was established to provide initial and immediate information about handling hazardous materials and other chemicals.

Therefore, the National Transportation Safety Board recommends that the Texas Railroad Commission:

Develop a system that would make fire suppression foam equipment readily available to emergency management agencies and local rural fire departments for the fighting of hazardous materials fires. (R-98-31)

In addition, the Safety Board issued Safety Recommendations R-98-18 through -25 to the UP and R-98-26 through -30 to the Federal Railroad Administration (FRA). The Safety Board also reiterated Safety Recommendation R-87-16 to the FRA.

The National Transportation Safety Board is an independent Federal agency with the statutory responsibility "to promote transportation safety by conducting independent accident investigations and by formulating safety improvement recommendations" (Public Law 93-633). The Safety Board is vitally interested in any action taken as a result of its safety recommendations. Therefore, it would appreciate a response from you regarding action taken or contemplated with respect to the recommendation in this letter. Please refer to Safety Recommendation R-98-31 in your reply. If you need additional information, you may call (202) 314-6430.

Chairman HALL, Vice Chairman FRANCIS, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in this recommendation.

By 
Jim Hall
Chairman

